Power Engineering

Tanners Creek—9300 Btu per kwh . 56

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65,000-hp Motors Drive Pumps 66

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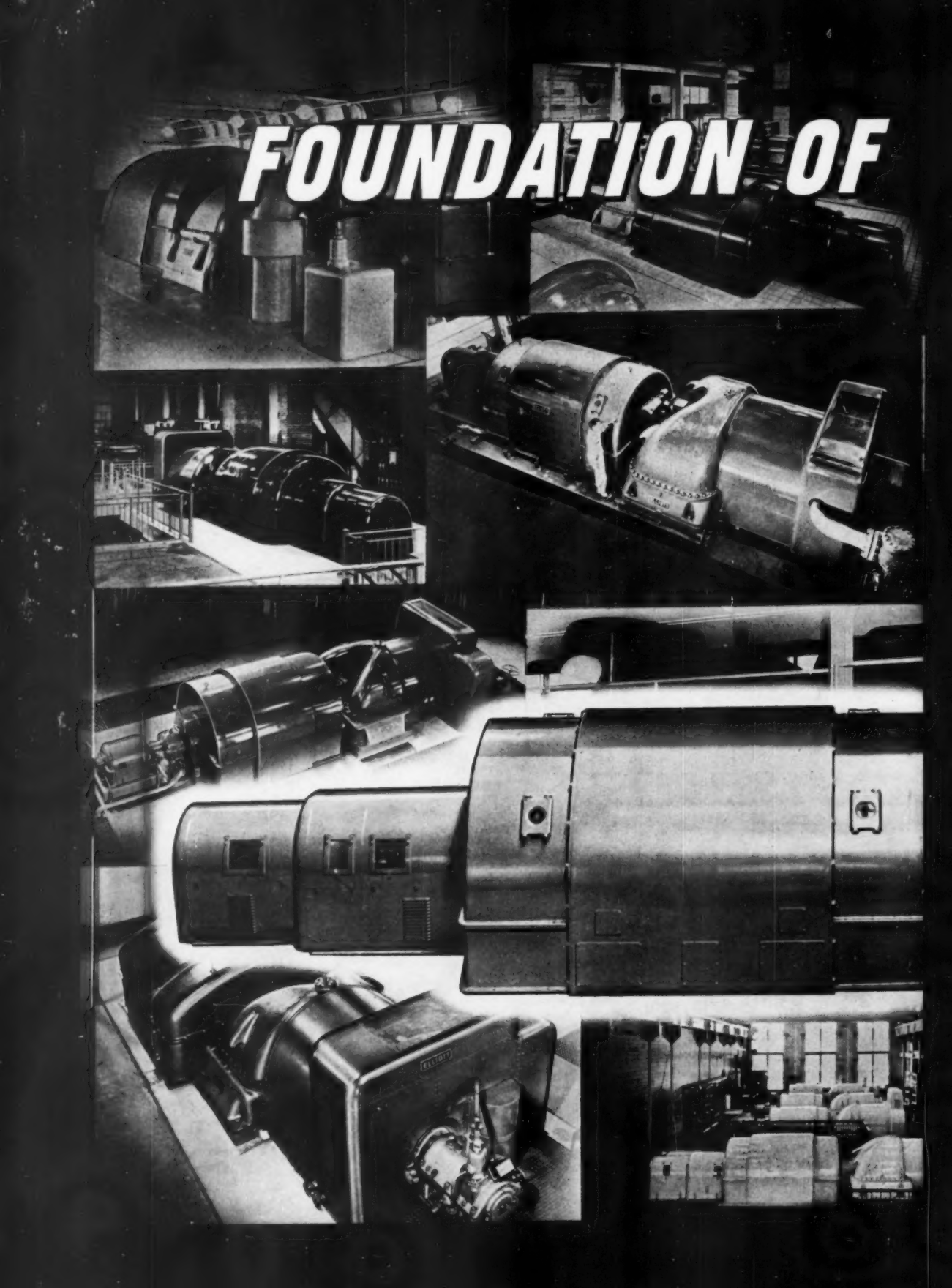
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Armstrong Blast Traps combine the benefits of quick heat-up with the dependable service of mechanical traps. There is no bellows to leak or collapse due to high pressure. In fact, the traps are hydraulically tested at 500 lbs. pressure before they leave the factory.

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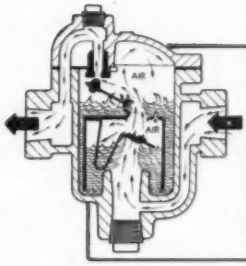
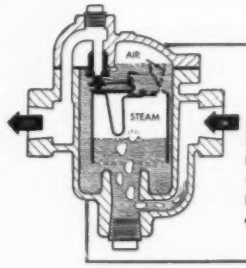


VENT OPEN

Note large air bubbles "whistling" through large thermic-control vent to be discharged with condensate through open trap valve. Shaded grey area is condensate.



VENT CLOSED

After accumulated air and condensate are discharged, large vent closes. Small vent is always open to handle ordinary volume of air entering trap.

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Phone: DEarborn 2-5446

NEW YORK: Richard Y. Fuller, Jr.
Oscar Wilds
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PHILADELPHIA: Oscar Wilds
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Power Engineering

Combining POWER PLANT ENGINEERING and POWER GENERATION

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September, 1951

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150,000-kw turbine generating unit, 2000 psi, 1050 F steam. One feature is use of television for remote observation.

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By W. B. Jarzembski

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While much development work is still to be done there are a number of immediate practical applications for this new "panelite" light source for central rooms and instrument panels.

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16 pages packed with practical operating and maintenance helps for every type of power plant. See complete separate contents page.

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By Albert Woodruff Gray

Significance to utility management engineers of recent U. S. Supreme Court decision declaring Wisconsin compulsory arbitration unconstitutional.

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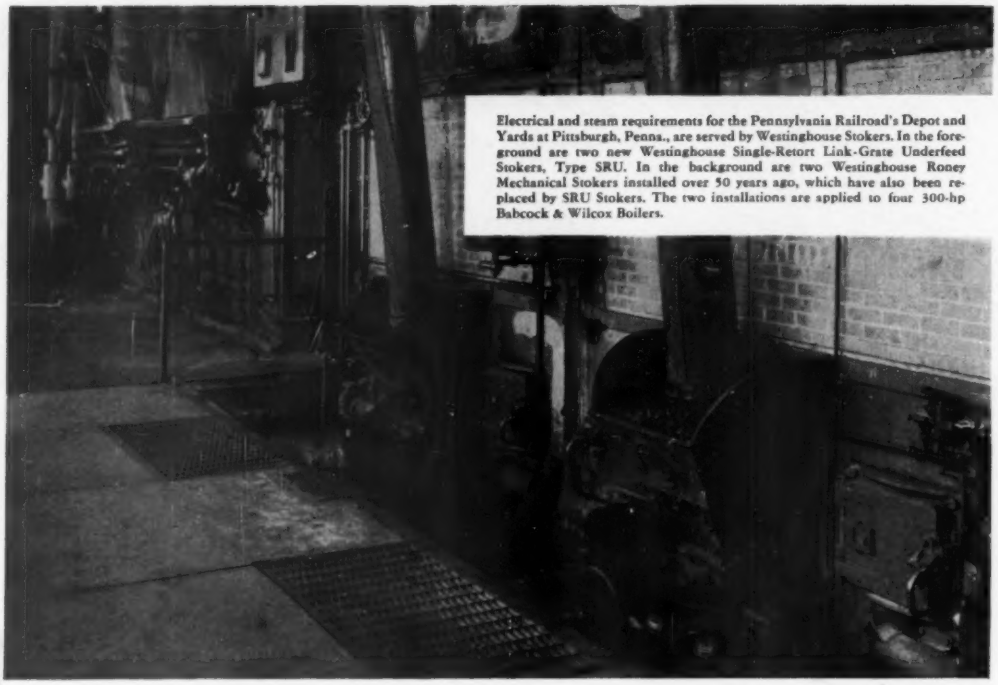
The only magazine devoted exclusively to the engineering interests and practical problems of power engineers



Electrical and steam requirements for the Pennsylvania Railroad's Depot and Yards at Pittsburgh, Penna., are served by Westinghouse Stokers. In the foreground are two new Westinghouse Single-Retort Link-Grate Underfeed Stokers, Type SRU. In the background are two Westinghouse Roney Mechanical Stokers installed over 50 years ago, which have also been replaced by SRU Stokers. The two installations are applied to four 300-hp Babcock & Wilcox Boilers.

One Long Run Deserves Another...

50 years of dependable service!

At the turn of the century, the Pennsylvania Railroad installed a bank of Westinghouse Roney Mechanical Stokers in their Pittsburgh Depot. After 50 years of dependable service... with a minimum of maintenance... they have been replaced by underfeed stokers.

Recently, it was found necessary to increase the capacity, and the Pennsylvania Railroad replaced the Roney Stokers with four Westinghouse Single-Retort Link-Grate Underfeed Stokers. The new Westinghouse Type SRU Stokers will burn a wider range of bituminous coals at better efficiency. This means savings in both higher efficiency and the use of low-priced coal, which can repay the entire installation costs within a short time. Smokeless operation at all loads is assured.

Westinghouse Single-Retort Stokers give medium-sized plants the advantages of underfeed stoker firing where available space and load do not justify the use of multiple-retort stokers.

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J-50531

YOU CAN BE SURE... IF IT'S

Westinghouse

STOKERS

ENGINEERS' PREVIEW

TAKING ISSUE with a definition of the National Production Authority that "neither maintenance nor repair includes the improvement of" a piece of equipment, J. B. Whitlock, general maintenance engineer of Armco Steel Corp., recently told the American Iron and Steel Institute that a progressive maintenance group must continually seek ways of making improvements.

If the NPA definitions were followed literally, the speaker said, no improvement would ever be made in the failure experience of a piece of equipment. Continual breakdowns of the same piece of equipment would also use more material in replacement than an improved material application would use by eliminating future failures.

The day of breakdown maintenance is now long passed. Greater emphasis is placed on preventive maintenance. Failure research is an important part of maintenance, continued Mr. Whitlock. Ten years of experience with this plan in his company has led to many problem solutions, and much valuable information from it has been catalogued in a manual.

★ ★ ★

TINY LAMP that dissipates odors through a triple output of ozone-inducing radiations has been developed by engineers of the Westinghouse Lamp Division. The ozone replaces unpleasant smells with clean, mountaintop air.

Three times as powerful as the ozone lamp introduced in 1945, the new "Odorout" bulb changes odor molecules in air instantly. This occurs as ultraviolet radiations of special wavelength transform the oxygen around the lamp into ozone, an air purifier.

The 3½ watt, walnut-sized lamp, when burned in a special wall fixture, destroys cooking, smoking, dampness, mildew and perspiration odors. It is recommended for use in kitchens, living rooms, dining rooms, bedrooms, basements, clothes closets and medicine cabinets, and in physicians', dentists' and business offices. Thousands of ozone lamps already are in use in clothes dryers and washers, professional hair drying equipment and in beverage vending machines. The bulb alone lists at $1.30 and lasts six months when operated 24 hours a day. It must be burned in a special fixture with a current-controlling device such as a transformer. Eight manufacturers now produce special "Odorout" wall fixtures using one to four lamps in each unit. These range in list price from $6.95 to $18.95 including lamp.

★ ★ ★

COLD SYNTHETIC rubber latex, the first to approach natural rubber latex in service and wearing quality, has been announced by United States Rubber Co. The development is a major step toward complete independence from natural rubber supplies in the Far East. The need has grown particularly acute with the sharp rise in natural rubber prices since the start of the Korean war. Many types of synthetic rubber latex have been produced experimentally but the new "cold" varieties are the first of the GR-S or general purpose type, which promise to compete with natural rubber latex in large volume applications in the rubber industry. Actually there is no one all-purpose type. Seven varieties of cold rubber latex have already been developed.

EVERY AMERICAN must prepare for a first-team role in the greatest production drive in world history if the United States is to retain its peacetime health while building its global defenses, according to Chester H. Lang, General Electric Company vice-president.

New explosions of peak demand and productivity will not be limited to the area of military goods, but will occur in every phase of the nation's economy during the next five years, Lang declared.

First demand will be for producers' equipment. This demand will reach its peak in 1951, Mr. Lang said, and will mark the first phase of the mobilization plan — a phase aimed at increasing the nation's over-all productive capacity. The production spurt in this field will last, he predicted, until 1953, when the index for producers' equipment is expected to drop below the levels of the past three years.

The second in the staggered series of production peaks will be in military durables (tanks, planes, etc.), he said. With its accompanying "intense pressures" on metal and labor supplies, this will reach its high point in 1953, Lang forecast.

This in turn will be succeeded, he said, by a spurt in consumer durables, such as automobiles and major electrical appliances, with an anticipated peak year in 1954.

Lang stressed that these trends are not inevitable, and can be altered by any new factors injected into the economic picture. "Moreover," he added, "in case of all-out war, any forecasts must be scrapped completely."

The mobilization program to pile billions in defense output on top of a "whopping" civilian production was termed by Lang as "one of the most daring enterprises that any country ever has undertaken."

"It is designed to bring us security and lasting strength," he declared. "But if we lose our balance or shirk our responsibilities, the result can be galloping inflation and chaos."

Lang asserted that the entire mobilization program could easily be scuttled by a "whole new race of superboondogglers," which he expects will emerge in the coming years of crisis.

Under the heading of "termites already at work on the mobilization structure", Lang listed:

"Greedy people who place self before country.

"The lazy ones, willing to ride along with the boom, and taking no thought of the morrow.

"The timid ones, who say it can't be done.

"The hysterical ones, who want to hurl us into war regardless of the consequences.

"The wasteful ones, who use the emergency as an excuse for throwing money away.

"The stingy ones, who can't see that weakness costs more than strength.

"The opportunists, who will use the crisis to foist all kinds of bug-brained projects on the taxpayers."

These and others could easily destroy the entire program if the people will let them, Lang declared.

The role of the American businessman in combatting efforts to force a "slowdown" in mobilization plans is a vital one, he said.

"The $265,000,000,000 civilian economy of America undergirds the entire military structure. If businessmen fail to keep this civilian economy running at peak, the entire program will fall apart."

THE FABULOUS oil fields of Alberta, which alone supply one-third of Canada's current petroleum requirements, have raised that country's annual crude oil production to nearly one-half of its total needs. Contrasting this with domestic production which amounted to only seven per cent of consumption in 1947, the year of the discovery of the western oil deposits, Dr. Oliver B. Hopkins described the effect of this development on the economy of the west and Canada as a whole, in a paper before the ASME at Toronto.

★ ★ ★

WILLING WATER helps mine copper, it says here in *Sparling Metrograms* (which, as we have previously pointed out, is one of our favorite swiping magazines). This Willing Water has taken over the mining job in a certain copper mine in Mexico where rock mining is about played out, we are informed.

The idea seems to be to soak the mine and tailings with water, which dissolves the copper salts. The solution is pumped out ready for the next operation.

The operators buy up old tin cans, melt off the tin, pulverize the remaining iron and steel. Then they start to extract copper by trickling the solution over the iron particles, which become loosely plated with copper. In due time, the plated chips are sluiced off with more Willing Water. So water not only mines the copper salts but aids in the concentration.

Well, considering all the time we spent in the copper country of Michigan and all the talk we heard about leaching copper out of the mines, and all the work that has been done on it, we certainly would like to see some of this Willing Water at work.

★ ★ ★

NEW DEVELOPMENT in petroleum transportation is the use of aluminum pipe lines. The lightweight lines are said to be easier and less expensive to lay than steel. Lighter construction equipment can be used, the pipe does not require preliminary cleaning, does not have to be wrapped, and is much easier to weld than steel pipe. In operation, aluminum pipe is reported to have less internal friction than steel pipe.

★ ★ ★

AN OIL COMPANY is experimenting with a paint which changes color with temperature variations. Applied to boilers and heating equipment, the paint provides at a glance an indication of the inside temperature. On an engine, the paint will tell the temperature of the various parts.

★ ★ ★

NEW PROTEIN spot digestant for dry cleaners effectively "eats and digests" stains from clothing, says Pabst Brewing Co.

★ ★ ★

TOTAL PRESENT estimated cost of the Louisville and Jefferson County Metropolitan Sewer District for a Treatment Plant, intercepting combined sewers and the District's portion of the four joint-use pumping stations is about $10,500,000. The tentative construction program calls for completion of the whole project within six years, if not delayed by the national emergency. The details of this plan were enumerated recently by L. S. Vance, Technical Adviser to the Louisville and Jefferson County Metropolitan Sewer District before the ASCE at Louisville, Ky.

EFFECT OF MOISTURE on thermal conductivity has long been of concern to the users and producers of thermal insulating materials. ASTM Committee C-16, at its meetings in Cincinnati on March 6 to 8, outlined an extensive research project to study this problem. Several new test methods were recommended for letter ballot approval, including one for determining density of preformed block insulation, density of preformed pipe insulation, and blanket type pipe insulation. In addition, a new specification for molded type mineral wool pipe insulation for high temperature and a tentative definition of the term "structural insulation board" were recommended.

Other proposed standards being developed include a sampling procedure for block and pipe insulation, specification for diatomaceous earth insulation, a linear expansion test method on insulating board using Forest Products Laboratory apparatus, and a method of test for determining adhesion of dried thermal insulating cement. Cooperative tests to evaluate a new method for measuring plasticity of insulating cement at any water-cement ratio, and round-robin tests to establish the maximum rise in temperature limits in measuring specific heat are under way.

It was announced that three proposed new specifications had received a satisfactory vote and will be presented to the Society for approval. These specifications cover mineral wool felt insulation, mineral wool industrial batt insulation, and mineral wool blanket insulation (metal mesh cover). A statement on combustibility as well as a test method, is being developed for blanket insulation. For full information, write to chairman of Committee C-16, E. R. Queer, Pennsylvania State College, State College, Penna.

★ ★ ★

THE FIGHT WASTE plan, developed and promoted by Henry Disston & Sons, Inc., of Philadelphia, is now operating in hundreds of plants throughout the nation, and Disston has just announced an extension of the campaign — a drive to get steel scrap into the channels of distribution. The steel scrap situation is growing more serious weekly.

Since Disston is both a producer and a consumer of steel, the company is aware of all aspects of the scrap problem. The company has prepared a leaflet which is offered to the trade in any quantity without charge. This discusses the importance of scrap to the steel industry, and the vital nature of the present emergency. It differentiates between *production* scrap, which generally flows through the regular channels back to the steel mills, and *dormant* scrap, in the form of obsolete parts and machinery, which is often overlooked.

The leaflet points out that real profits can be realized through scrap, and gives advice on the organization of a salvage committee within any plant to further the efficient handling of scrap.

The U. S. economy needs steel, and the steel industry needs scrap. Disston feels that every plant which uses steel can play a part in this all-important drive. For details of its plan, write Disston at Philadelphia or William K. Harriman, Gear-Marston, Inc., 21 South 12th St., Philadelphia, Penna.

★ ★ ★

SUPER VACUUM BOTTLE is copper sphere immersed in liquid nitrogen. It holds liquid helium at eight degrees above absolute zero for 100 days, makes it possible to ship helium as a liquid in thin-walled containers at ordinary atmospheric pressure.

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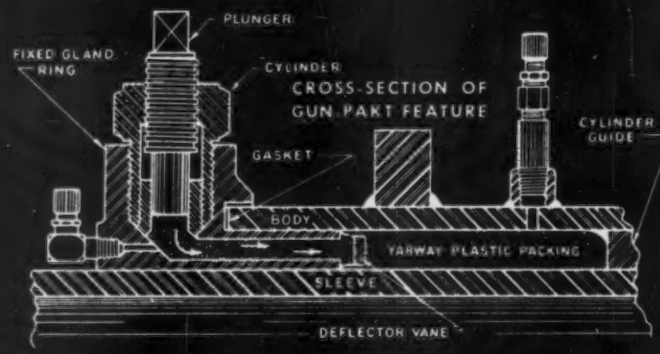

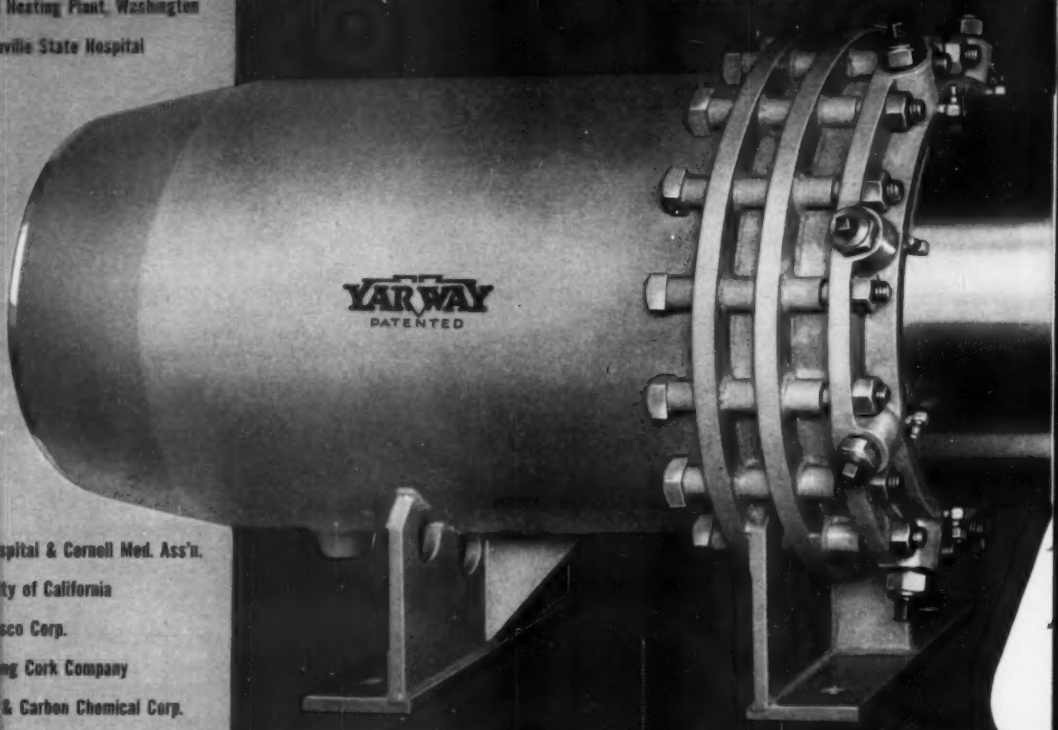

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What feature do you want most in an expansion joint . . . sure movement, simplified installation, ease of servicing, low cost, low upkeep?

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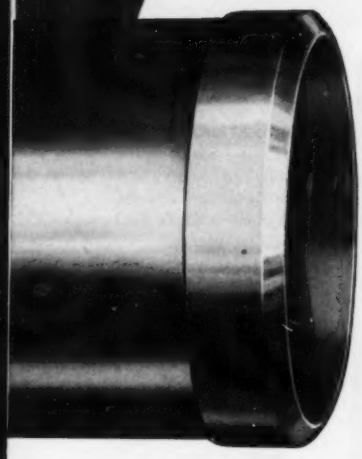
The high factor of safety in Yarway Gun-Pakt Expansion Joints prevents shutdown losses—eliminates accident hazards.

Gun-Pakt Joints are *rugged* joints, strong and dependable. They are *serviced under full steam pressure.* Packing is added simply by inserting a plug of Yarway plastic packing and turning a wrench . . . the joint's tight, the job done.



Yarway Single-end Gun-Pakt Expansion Joint, welding type. Double-end and flanged types also available.

FEWER JOINTS NEEDED

With Yarway Gun-Pakt Joints you need fewer joints per length of pipe line. Each sliding sleeve may have a traverse of either 4", 8" or 12" . . . maximum expansion being 24" for a double-end joint.

Gun-Pakt is more than just another expansion joint—it is a revolutionary idea in expansion joint engineeri... success is shown by wide use in leadi... stations, institutions and ...

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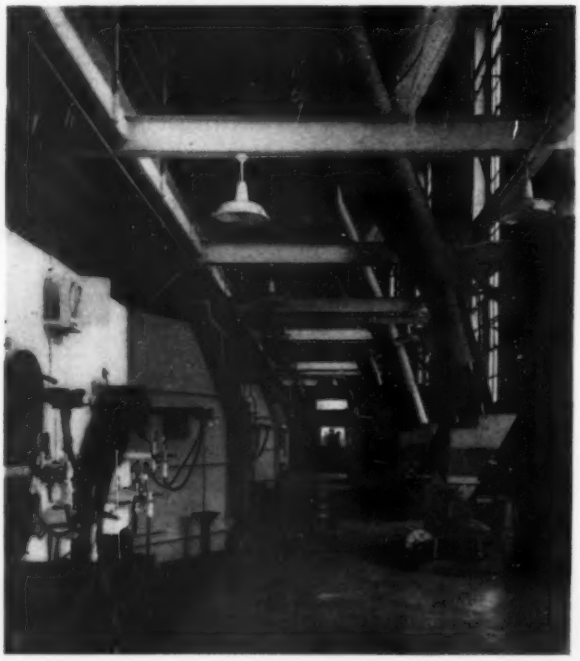
THE C-E VERTICAL

"...enables us to handle load swings up to 100,000 lb per hr...



Looking down the firing aisle of Baldwin's fine modern steam plant containing three 160,000 lb per hr C-E Vertical-Unit Boilers; pressure, 300 psi; temperature, 450 F. The feeders for the C-E Raymond Bowl Mills, located on the floor below, are shown at the right. C-E combination coal-oil burners are seen in the left foreground.

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ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

UNIT BOILER...

...has reduced our coal consumption by 30,000 tons per year."

Mr. Michael J. Buckley, Superintendent of Power Plant of the Baldwin-Lima-Hamilton Corporation — Eddystone Division, in the January-February issue of *Meters and Controls* tells of his experience with the C-E Vertical-Unit Boiler:

"Formerly we had three boiler rooms containing two sets of four boilers and one set of eight boilers respectively. These units were 40 years old and could not be used to their full rated capacity. In 1945 the entirely new power plant was erected, containing three 160,000 pounds per hour 300 psi Combustion Engineering—Superheater boilers, total steam temperature 450 F.

"The new steam generating units have given us greater and more flexible capacity (handling load swings up to 100,000 lb per hr), has reduced our coal consumption 30,000 tons per year, has enabled us to cut our power plant labor force by forty-two men for the winter operation and has decreased our maintenance expense.

"We planned the installation for using either pulverized coal or oil, and have found that provision to be an excellent one. We can change from one fuel to the other quickly, enabling us to use whichever fuel is cheaper."

C-E is frank to acknowledge—and glad to credit—the exceptionally careful and intelligent operation of these VU Boilers by the Baldwin operating personnel. And this combination of correctly designed equipment, expertly operated, is paying handsome dividends.

For hundreds of plants throughout the United States, representing virtually every type of industry, C-E Vertical-Unit Boilers have proved to be the one best answer to operating economy and efficiency. How about your plant? Our engineers will be glad to work with yours, towards lower steam costs, whatever your requirements may be. B-512

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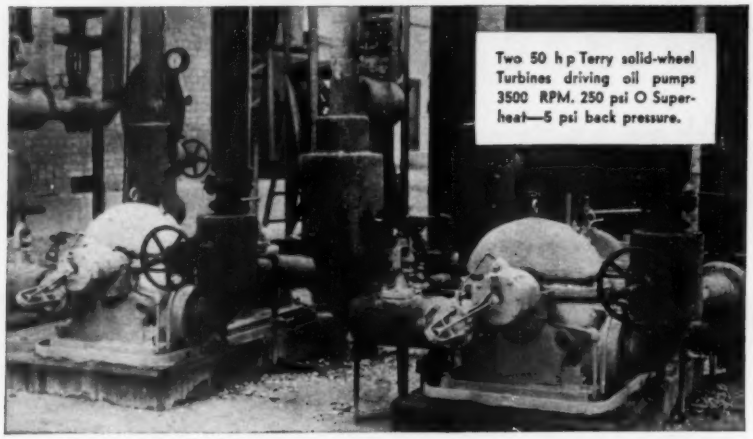

Two 50 h p Terry solid-wheel Turbines driving oil pumps 3500 RPM. 250 psi O Superheat—5 psi back pressure.

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Terry Turbine blades have the protection of generous radial and axial clearances. Axial clearance is so large—a full inch—that end play can do no damage.

Projecting rims at both sides of the wheel give further protection to the rotor buckets. Should clearance become reduced, these rims will take rubbing without damage to the blades.

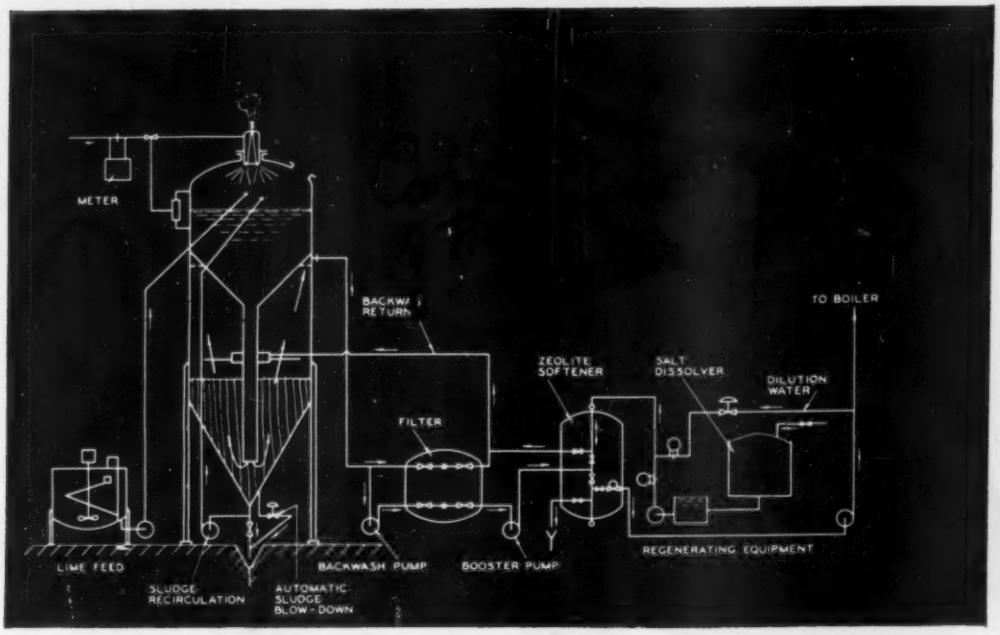
This construction also makes frequent inspection of thrust bearings unnecessary.

A request on your business letterhead will bring you Terry Bulletin S-116 giving detailed information about these features and other Terry Turbine advantages.

If you have a specific turbine drive job in mind, our district Terry representative will be glad to discuss it with you.

T-1174

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.



COCHRANE HOT PROCESS ZEOLITE SOFTENER

1. saves chemicals
The zeolite softener uses salt instead of the more expensive soda ash and phosphates, bringing down the cost of chemicals considerably.

2. saves on capital investment The cost of adding zeolite equipment to a hot process installation is far less than the addition of an independent sedimentation tank and chemical feed for a two-stage phosphate process.

3. lower CO_2 in steam
The lower alkalinity resulting from using lime alone, plus the fact that this alkalinity is all carbonate, causes a reduction in CO_2 generated in the steam.

4. less operating attention The use of the zeolite softener with its simplicity of operation is an advantage which is enhanced by the longer periods between regenerations, due to the lower hardness of the hot process softener effluent.

5. less floor space and head room required
The addition of the zeolite equipment requires less floor space and less head room than that required for two stage phosphate equipment.

6. lower alkalinity The use of lime (or Dolomitic lime) as the sole reagent in the hot process means that the alkalinity can be reduced to about half that obtained with lime and soda ash.

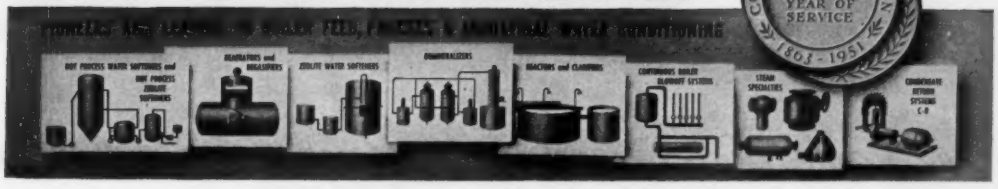
7. only one chemical needed in the hot process It is generally possible to use a single reagent in the hot process, namely lime or Dolomitic lime, precipitating the bicarbonates and magnesium, leaving the remaining hardness to be removed by the more economical zeolite.

Write for a copy of Publication 4801, giving complete details on this new and economical process

COCHRANE CORPORATION • 3123 N. 17th St. • Philadelphia 32, Pa.

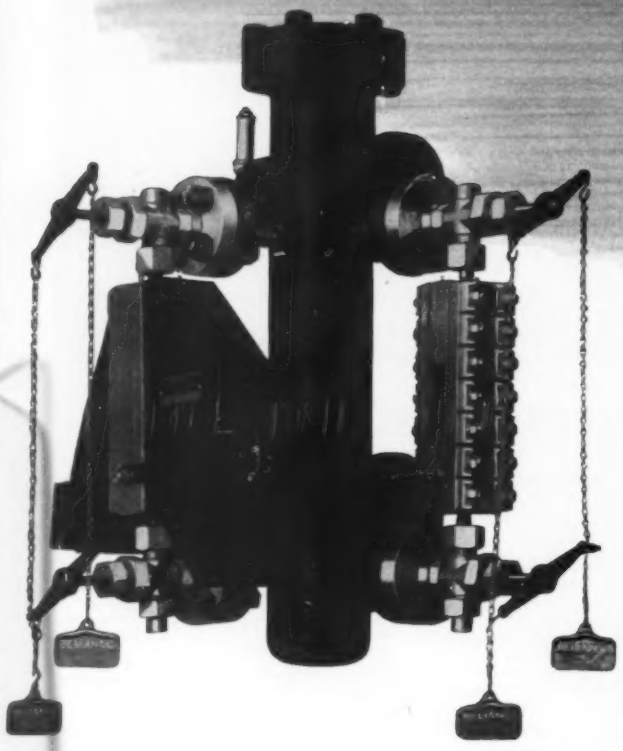
In Canada: Canadian General Electric Co., Ltd., Toronto • In Mexico: Babcock & Wilcox de Mexico, S. A., Mexico City • In Europe: Recuperation Thermique & Epuration, Paris

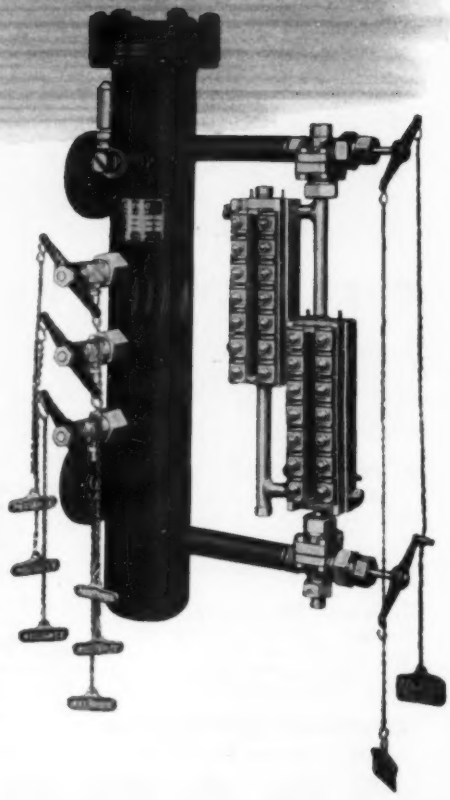
COCHRANE



RELIANCE WATER COLUMNS

for any working steam pressure assure you the *utmost*





Reliance Boiler Safety Devices include Water Gages and other trim for all working steam pressures. Also EYE-HYE, the original all-hydrostatic remote reading water level indicator.

The name that introduced safety water columns...

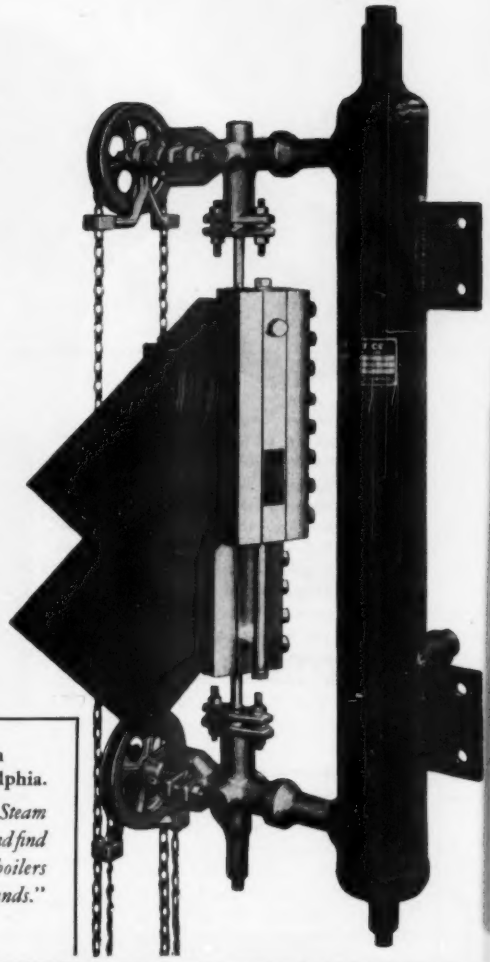
in Dependability

SINCE 1884, Reliance has maintained leadership in Boiler Safety Device development and manufacture. Water Columns with automatic Alarms, operated by the original *instantaneous* alarm mechanism, have helped to fortify power plants against the consequences of boiler water failure for billions of operating hours. Alarms are available on columns for pressures to 900 psi.

For higher pressures, Reliance provides standard and custom-built equipment that embodies principles of design and construction perfected in 67 years of *specializing* in this field—"super-rugged" Water Columns built with a generous extra margin of safety.

Selected as standard equipment by many boiler manufacturers and consulting engineers, Reliance Water Columns exceed the requirements of national and state code authorities. Check with your consultants or ask for our nearest engineer representative.

THE RELIANCE GAUGE COLUMN COMPANY
5902 Carnegie Avenue • Cleveland 3, Ohio



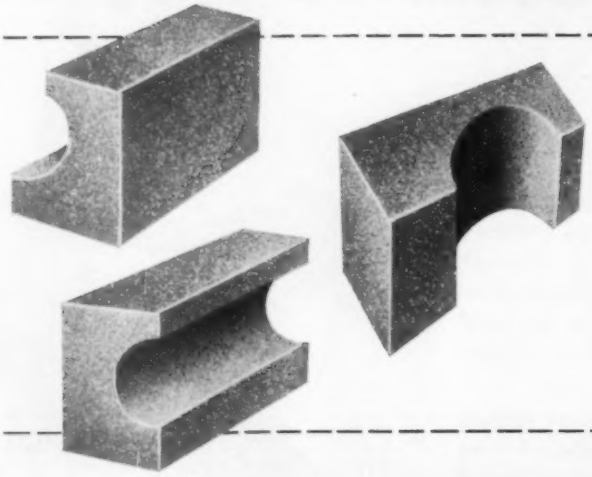
Letter dated May 29, 1896 from Kalion Chemical Company, Philadelphia.

"Gentlemen: We have equipped our entire Steam Plant with your Safety Water Columns, and find them perfectly satisfactory. One of our boilers has a working pressure of over 175 pounds."

...in 1884 ⇨ **Reliance®**

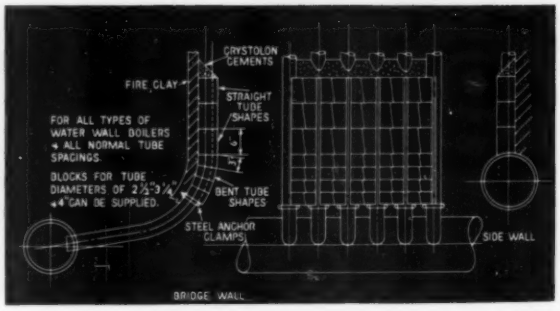
BOILER SAFETY DEVICES

LASTING, LOW-COST PROTECTION
for Your Water Tube Boilers
with CRYSTOLON* Armor Blocks



Made Of Top-Quality Silicon Carbide, Norton CRYSTOLON Armor Blocks have the necessary refractoriness to withstand today's extremely high boiler furnace temperatures. Equally important is their high resistance to slag penetration and abrasion. Due to their high thermal conductivity, they promote even heat distribution, and afford maximum protection to tubes from localized heat generation and flame impingement.

Installation Is Easy And Inexpensive, thanks to the simplified design of CRYSTOLON Armor Blocks. Adjoining surfaces of blocks are tapered, for secure locking and to maintain intimate contact with the tubes. Available for both bent and straight tube sections, these blocks can be replaced entirely from the fire side of the boiler. They are laid dry, further reducing installation costs, and tubes require no cleaning or grinding, as when cast iron blocks are replaced. When small areas are to be protected against flame impingement, blocks can be held correctly in place by clamps fitted around the tubes.


CRYSTOLON CEMENTS
FIRE CLAY
STRAIGHT TUBE SHAPES
FOR ALL TYPES OF WATER WALL BOILERS + ALL NORMAL TUBE SPACINGS.
BLOCKS FOR TUBE DIAMETERS OF 2½-3¼" CAN BE SUPPLIED.
BENT TUBE SHAPES
STEEL ANCHOR CLAMPS
SIDE WALL
BRIDGE WALL

Whatever type or make of water tube boilers you're using, you can depend on CRYSTOLON Armor Blocks for thorough protection and economy. For prices and full information, send data on tube diameters, tube spacing, radius of curvature in bent-tube sections, and dimensions of areas to be covered. Refractories Division, NORTON COMPANY, 616 New Bond Street, Worcester 6, Mass.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

NORTON

Special REFRACTORIES

Making better products to make other products better

Canadian Representative
A. P. GREEN FIRE BRICK CO., Ltd. TORONTO, ONTARIO

IT ALWAYS PAYS TO SPECIFY

LADISH

Controlled Quality

PIPE FITTINGS

...to be sure of sound welds and fast assembly

Ⓛ
TO MARK PROGRESS

Keeping welding costs down to a minimum and erection schedules on time... these are important advantages you can assure to any piping job by installing Ladish Controlled Quality fittings. Metallurgical controls over materials and methods provide an assurance of uniform weldability in every Ladish fitting... and thorough inspection to rigid standards of physical dimensions and geometric accuracy assures fast piping assembly.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • Havana • Toronto • Mexico City

LOW COST DEPENDABLE COAL HANDLING FOR PUBLIC UTILITIES

Salem Gas and Light Company, Salem, Mass., found a G-W Skip Hoist the ideal solution to the problem of conveying coal and coke to producer storage. The skip bucket keeps the producer-storage bin filled at all times . . . and does the job with maximum economy.

Gifford-Wood Skip Hoists . . . one of many G-W systems of materials handling . . . are low in initial cost . . . low in maintenance . . . long-lived . . . completely dependable. Public utility companies the country over are becoming increasingly interested in Skip Hoist handling of coke, coal and ashes where space is limited and both initial and operating costs must be kept at rock bottom.

This particular installation may not be the perfect solution to your own particular problem. Gifford-Wood, however, has specialized in the design, engineering and installation of all types of materials handling systems for 136 years. To have a Gifford-Wood Materials Handling Engineer survey your present method of moving materials, places you under no obligation and it may well be your first step toward lower operating costs and increased production.

GIFFORD-WOOD CO.

Since 1814
HUDSON, NEW YORK

NEW YORK 17, N. Y. 420 WASHINGTON AVE. • ST. LOUIS 1, MO. RAILWAY EXCHANGE BLDG. • CHICAGO 6, ILL. 565 W. WASHINGTON ST.

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When You Think of Materials Handling — Think of Gifford-Wood

NOW STANDARDIZED

3 Precision Controls for All Speed Problems

Here's governor standardization that "pays off". Now you can economically solve all speed-control problems with only three basic governors.

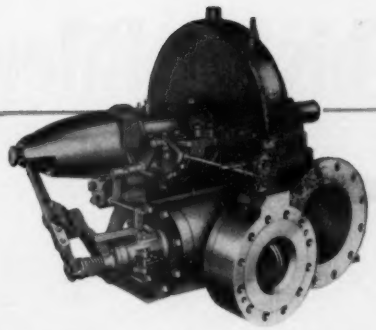
Costly special engineering is eliminated. Advanced design gives an unusual degree of flexibility... with precise speed control for all steam conditions. Results? Initial costs are lower... shipments are quicker... spare-parts inventory is reduced.

Designs for three basic classes of steam conditions, three wheel sizes, and three types of governors provide, in effect, twenty-seven standard variations to cover a wide range of applications. All oil-governed, direct-connected Type E units include the standard reservoir-type base, as illustrated. What's more, Type E governors can meet a great number of special requirements with optional accessories. This standardization results directly from Westinghouse's wide experience in all industry.

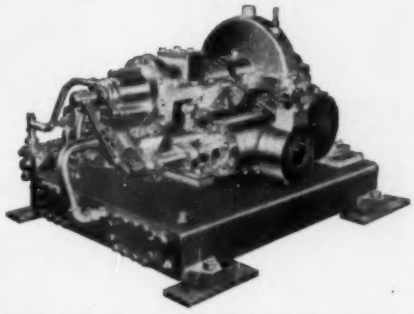
Other outstanding maintenance-saving features on the Type E turbine are Dual Protection... Weather Protection... Centerline Support... and a Rugged Governor Housing. Ratings are available from 5 to 1,500 hp.

For complete information ask your nearby Westinghouse representative for Type E Turbine Book B-3896, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

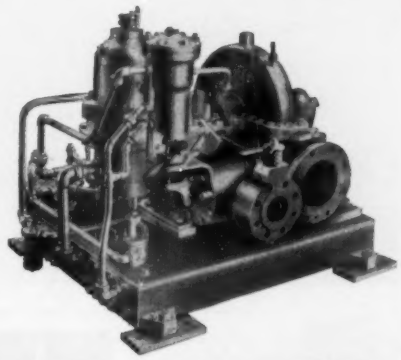
YOU CAN BE SURE.. IF IT'S
Westinghouse
TYPE E Turbines



Shaft-Type Governor. For narrow speed-range applications, this governor automatically positions the steam admission valve to control turbine speed within close limits—*6 to 8% speed regulation.*



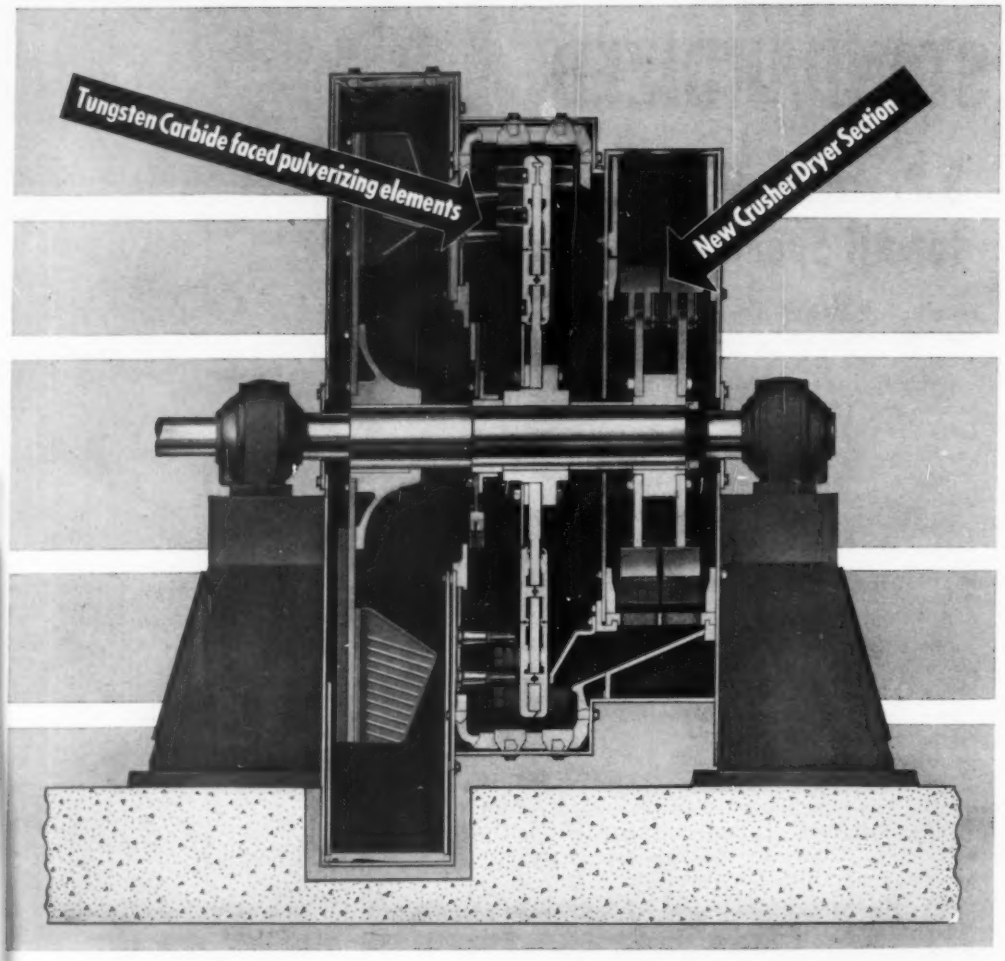
Hydraulic-Orifice Governor. For wide speed-range applications such as drives for fans, blowers, and compressors —*3-to-1 speed-adjustment range; 6% speed regulation.*



Vertical Oil-Relay Governor. For narrow-range precision-control applications such as drives for generators, pumps, blowers and compressors—*33⅓% speed-adjustment range; 4% speed regulation.*

I-50527

This new Riley Pulverizer gives you



TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Atlanta New Orleans St. Louis Kansas City St. Paul Tulsa Houston Denver
Salt Lake City Los Angeles Portland Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

these added significant advantages

No capacity reduction with increase in moisture.

In the crusher dryer section where coal is crushed to a fine granular state, approximately 40% through a 50 mesh screen, representing about 5% of the work to be done, free moisture is evaporated from coal. The crusher dryer section acts as a flash dryer. Coal then enters pulverizing section where 95% of the work is done, completely free of moisture which would affect pulverizer performance and capacity. The crusher dryer section is designed with ample capacity for the highest moisture coals and as moisture is evaporated before coal enters the pulverizing section, moisture has no effect on pulverizer capacity or performance.

Tramp iron, iron pyrites and other foreign materials in coal rejected.

The crusher section of the pulverizer rejects tramp iron, iron pyrites and other hard foreign substances in the coal, preventing any materials from entering the pulverizer section which could cause damage.

Pulverizing elements faced with tungsten carbide.

Pulverizing elements are faced with tungsten carbide, assuring long periods of service without outage for maintenance and resultant low maintenance costs. Numbers of Riley pulverizers equipped with tungsten carbide faced parts have been in operation over two years without showing appreciable signs of wear, indicating at least several additional years of service before replacements are necessary. Over 50,000 tons of coal have been pulverized by a mill having a six-ton per hour capacity with indications that well over 200,000 tons will be pulverized before requiring replacement.

Fineness sustained over years of operation.

Because the life of the tungsten carbide faced pulverizing elements is so long, fineness of pulverization is maintained over years of operation. Tests on existing installations show no falling off of fineness after over two years of operation. No adjustments are necessary to maintain fineness.

Unusually high capacity per unit of space.

The improved Riley pulverizers have an unusually high capacity per unit of floor space and height, permitting their installation under crowded space conditions. A Riley Pulverizer having a capacity of 20 tons per hour with 50 grindability high moisture coal is only 11'9" wide, 10'0" deep and 7'6" high and weighs only 46,780 lbs. Because of their lower weight and quiet vibrationless operation, heavy foundations are not required.

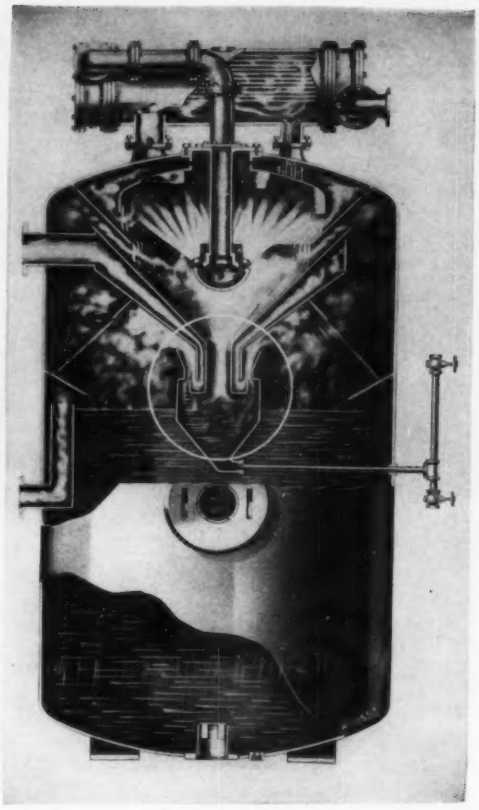
If you are interested in coal pulverizers, we believe you will find the article "THE USE OF TUNGSTEN CARBIDE IN COAL PULVERIZERS," presented at the fall meeting of the A.S.M.E., well worth reading. We will be happy to mail a copy to you without charge on request.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS



Hard scale, formed on the trays of deaerating evaporator preheaters, is no longer the big problem it used to be.

In a large central station (name on request), the preheaters had to be cleaned every three weeks, and the units were completely shut down at that time from eight to ten hours.

Then Worthington steam-jet deaerators were installed—with a "blowdown" head designed by Worthington engineers. This special head allows the operator to remove harmful deposits at regular intervals *while the unit continues in service.* It also provides for simple and speedy acid cleaning of critical parts, when necessary, without even opening an access door or removing any parts from the unit.

Compare The "Time-Outs"

The Worthington unit, given a short blowdown once each shift, stays in continuous operation with maximum deaeration for periods of at least 8 months. When the acid treatment is given at the end of that period, the job is finished in under three hours.

Compare this with the former record. *Then*—8 to 10 hours outage every three weeks and labor by a *crew* of men. Now—with Worthington's blowdown head—operation uninterrupted during regular short blowdown, with a shutdown for acid cleaning only once in almost a year, requiring only one man and three hours!

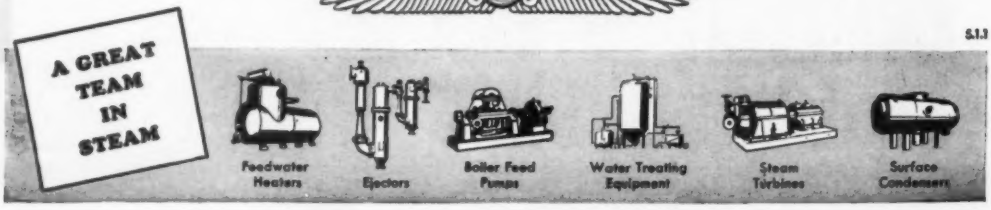
Worthington Makes Deaerating Equipment News

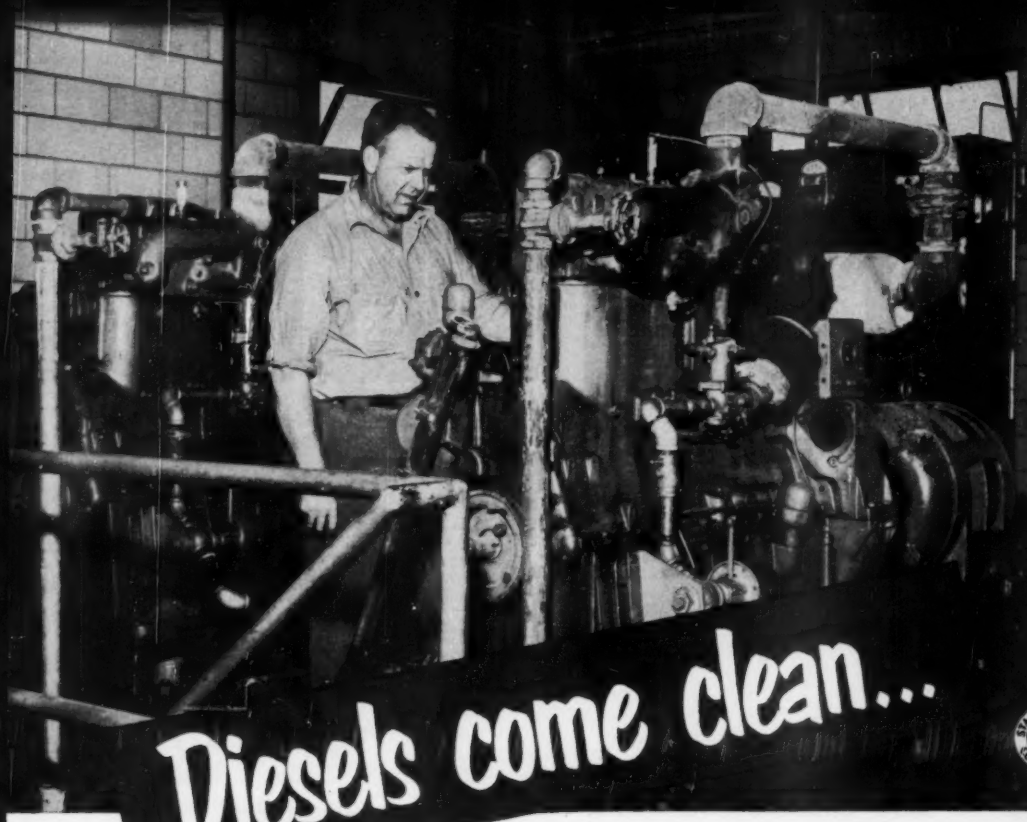
Developments like this, applicable to any deaerators operating under conditions of scaling, are typical of Worthington's engineering firsts in water treating and deaerating equipment.

Worthington manufactures all of the equipment needed in a complete water treating installation. For further information on why *there's more worth in Worthington*, address Worthington Pump and Machinery Corporation, Steam Power Div., Harrison, N. J.

WORTHINGTON

S-1-J





Diesels come clean...

more time between overhauls

These two 50-HP diesel engines, serving in a midwest sewage disposal plant and utilizing sewage gas as fuel, had to be shut down on an average of every three months to have stuck rings and valves freed and crankcases cleaned of sludge.

Then a Standard Oil lubrication specialist recommended STANDARD HD Oil. Sticking of rings and valves has been eliminated. The engines have stayed clean, operating for as long as two years between overhauls. Operators report a 20% reduction of oil consumption.

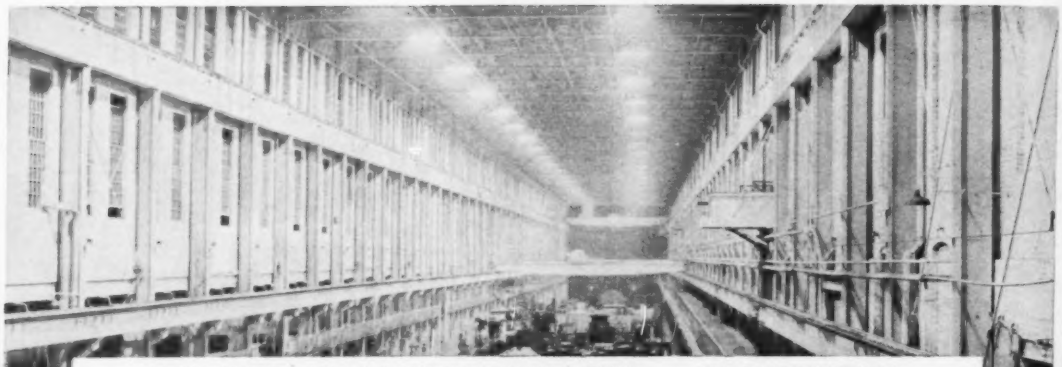
This plant's success in lowering maintenance costs is typical of the results gained by STANDARD HD users wherever operating loads are severe and/or fuel quality is adverse. To apply the benefits of STANDARD HD Oil in your own diesel operation, call for the services of your local Standard Oil lubrication specialist. Contact your Standard Oil Company office or write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD HD
TRADE MARK
OIL

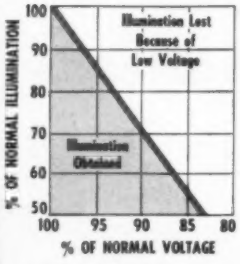
STANDARD OIL COMPANY STANDARD *(Indiana)*

Allis-Chalmers

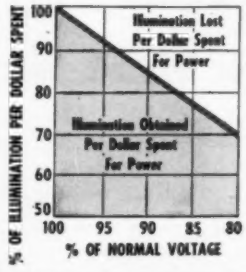
STOP Wasted



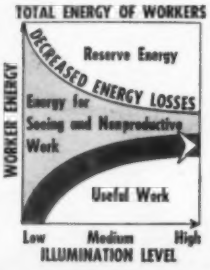
HOW UNDERVOLTAGE WASTES MAN-HOURS . . . CUTS PRODUCTION



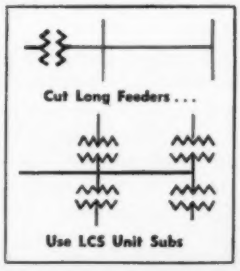
GOOD ILLUMINATION demands that rated voltage be maintained to all lighting fixtures. Illumination falls off rapidly on undervoltage . . . light output of filament bulbs is cut in half when voltage falls about 17%. Poor lighting causes eye strain . . . slows down workers . . . makes inspection difficult . . . causes increased scrap.



YOU PAY for illumination you don't get when you operate your distribution system at undervoltage. For example: at 10% undervoltage, illumination is cut 30% but power consumption is cut only 15%. Eliminate this power waste . . . get all the power you pay for by maintaining full voltage to all lighting fixtures.



MORE ENERGY AND TIME for useful work results from quicker seeing in well illuminated plants. In one case illumination was increased from 6 to 16 ft. candles (an increase from 83% to full voltage) . . . resulting in a 9% increase in production—20% decrease in accidents. Again, production increased 25% with an increase from 6.8 to 24.5 ft. candles.



A MAJOR CAUSE of undervoltage is the voltage drop in secondary feeders. Long lines of heavy copper carrying power at low voltage may prove inadequate as production schedules are stepped-up and new machines added. Install Allis-Chalmers LCS Substations at load centers to cut feeder length, reduce voltage drop and increase production.

Unit Substations

Manhours!

By Improving Illumination

BOTH MACHINERY AND PERSONNEL gain efficiency when you install unit substations to correct undervoltage. That's because no worker can do his best *unless* his job is well lighted . . . no electrical equipment gives top performance *unless* it operates at proper voltage.

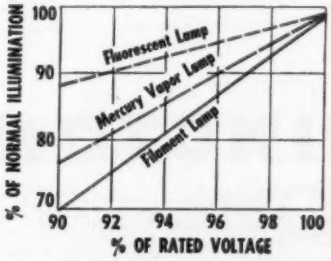
Filament bulbs, for instance, give 15% less than rated light when voltage falls only 5%. On undervoltage, fluorescent tubes and mercury lamps give less than rated light, are difficult to start, may flicker and go out. And when you operate at undervoltage, you are paying for power you're not using.

Eliminate power waste . . . manhour loss. Workers are more efficient, produce more work of better quality when illumination is adequate. Put *all* the power and manhours you're buying to work by maintaining proper voltage to all equipment. Install Allis-Chalmers LCS Unit Substations at load centers and eliminate long runs of expensive low voltage cable. Allis-Chalmers LCS Load Center Unit Substations are neat, compact, easy to install and provide protection to personnel.

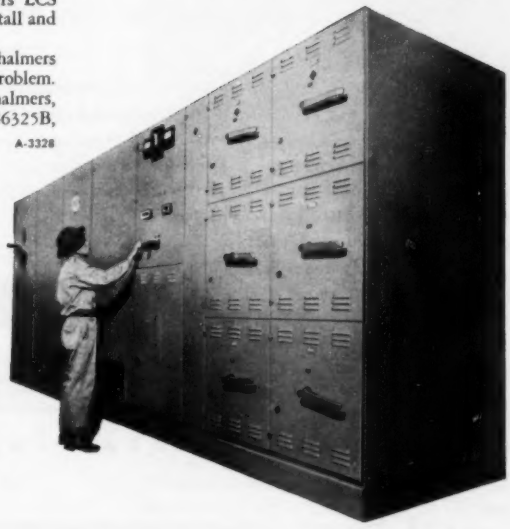
You can count on the cooperation of experienced Allis-Chalmers substation engineers in working out your distribution problem. Get in touch with your A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for bulletins 11B6285A, 11B6325B, and 11B6895.

A-3328

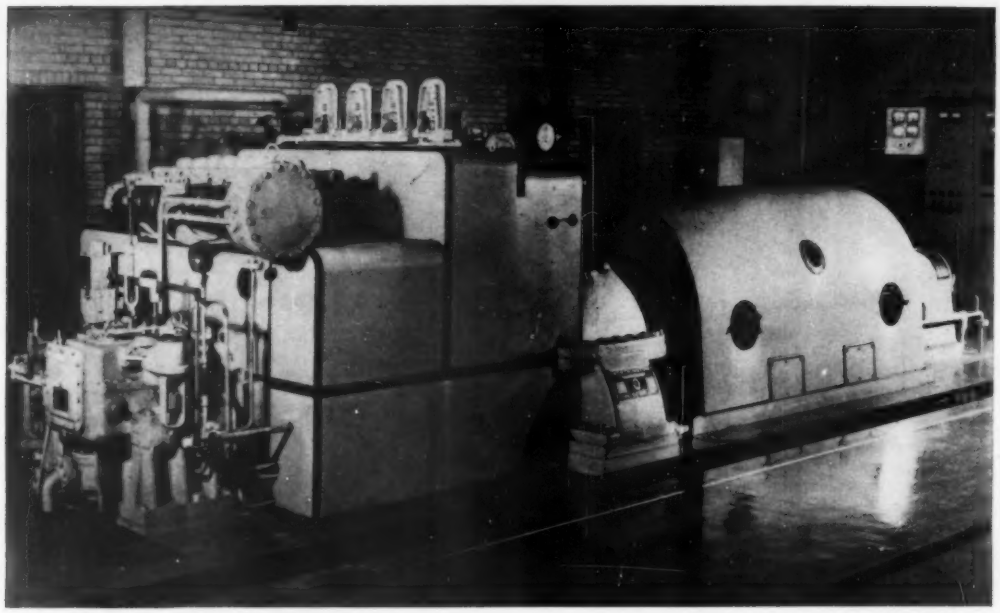
LCS Unit Substations



Undervoltage reduces the light output of filament, fluorescent and mercury vapor lamps. Although light output is least affected on fluorescent lamps, undervoltage makes them flicker, hard to start. Mercury lamps go out altogether at 10% undervoltage . . . require up to 20 minutes to regain full light output.



ALLIS-CHALMERS



Story of an Economy Drive

How the Worthington Steam Turbine Pays Dividends for the City of Litchfield

What happened at Litchfield, Minnesota, is a clue to a most economical power plant operation.

Originally, the Litchfield municipal power plant consisted of low-pressure boilers, a steam engine and a small turbine-generator unit. The exhaust steam is sold for municipal heating.

Next—a Diesel engine-driven generator was installed. The load grew, and finally, after a careful survey, it was decided to install a 3000-kw Worthington turbine generator and automatically extract steam for heating purposes.

Worthington builds steam turbines in all types and sizes—and turbine-generator sets up to 10,000-kw. For proof *there's more worth in Worthington*, call our nearest office or write to Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, New York.

WORTHINGTON

STEAM TURBINE GENERATORS

T.1.9

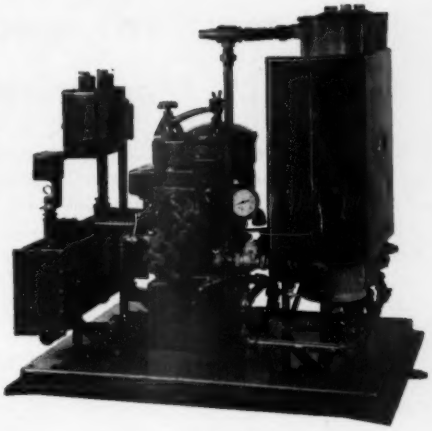
A GREAT TEAM IN STEAM

A DE LAVAL "PURI-FILTER" THROWS ALL THREE OUT

Dirt, water and carbon are all promptly removed from diesel lubricating oil by the De Laval "Puri-Filter." Dirt is thrown out and stored in the bowl of the centrifuge. Water is separated from the oil and continually discharged to waste. Then the purified oil is passed through filters which remove all remaining impurities including colloidal carbon.

The "Puri-Filter" is the surest way there is to make certain that diesel lubricating oil is properly clean — it leaves absolutely nothing in the oil that can contaminate it or clog the lubrication system of an engine. Ring sticking is minimized; bearing life is increased.

The De Laval "Puri-Filter" yields other advantages. For example, it does not remove valuable additives from the oil. Moreover, it speeds up engine inspection and takes the curse off one of the dirtiest jobs in the power plant—crank case inspection.



• *Ask for Bulletin DL-1.*

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DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL

FOR DIESEL LUBRICATING OIL

Garlock
"Chevron" Seal

Wherever leakless operation is required—specify GARLOCK Mechanical Seals

When leakless operation of centrifugal or rotary pumps is required—particularly, if corrosive or inflammable liquids are being handled—GARLOCK Mechanical Seals will do the job.

These seals are composed of two main elements; one rotates with the shaft and the other is stationary. Since the stationary element does not contact the shaft, there is *no* wear on the shaft. A positive contact between carefully lapped metal-to-carbon or, metal-to-metal mating surfaces provides the leakless seal.

Users of GARLOCK Mechanical Seals have reported outstanding service records on a wide variety of applications. Here are just two taken from the many in our files:

- Over 3 years' service and still in operation, on a 1¾" shaft of a boiler feed pump handling water at 220°F. and 200 p.s.i., and operating at 3600 r.p.m.
- Two years' service, and still in operation, on a 1" shaft of a pump handling paint at 130°F., 10' Hd., operating at 1750 r.p.m.

GARLOCK manufactures mechanical seals in many standard and special designs from a wide range of high quality materials. For more information, write for our Mechanical Seal booklet or call your GARLOCK representative.

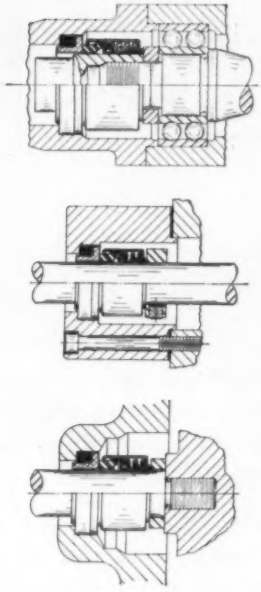
THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

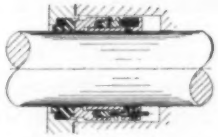
GARLOCK

TYPICAL APPLICATIONS of GARLOCK Mechanical Seals for Rotary Shafts

PACKAGE SEALS

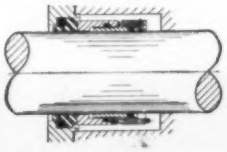


CHEVRON-TYPE SEALS



Type CB—Balanced "Chevron" Seal

"O" RING SEALS



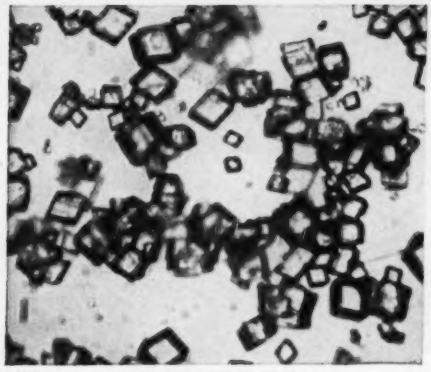
Type OB—Balanced "O" Ring Seal

ALLIS-CHALMERS

No. 26 Series

ORGANIC SLUDGE DISPERSIVE

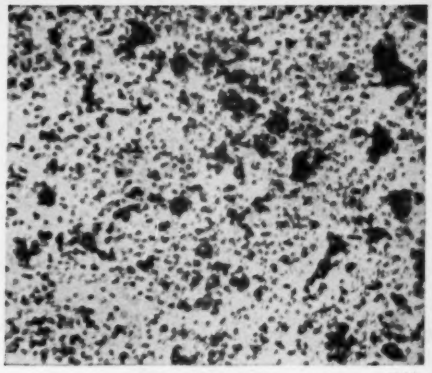
Controls Sludge-Scale



500X

UNTREATED

Note large crystal size



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TREATED

Inhibited crystal growth and dispersion keep sludge fluid

BOILER SLUDGE CAN FORM SCALE . . . because of its inherent tendency for adhering to heat transfer surfaces.

The dispersive property of Allis-Chalmers No. 26 Treatment prevents crystal growth and produces a fluid sludge, readily removed by blowdown.

To you, the engineer, this means cleaner boilers — boilers that seldom if ever require turbining or other forms of cleaning. No. 26 Treatment does not soften the water, but it can be mixed with softening chemicals (if desired) without reducing its effectiveness as a sludge conditioner. This simplifies its application and reduces your investment in feeding devices.

A COMPLETE, BRIEF discussion of the Allis-Chalmers No. 26 Series organic sludge treatment is available in our bulletin number 28X7543. (Coupon below for your convenience.)

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Milwaukee 1, Wis.

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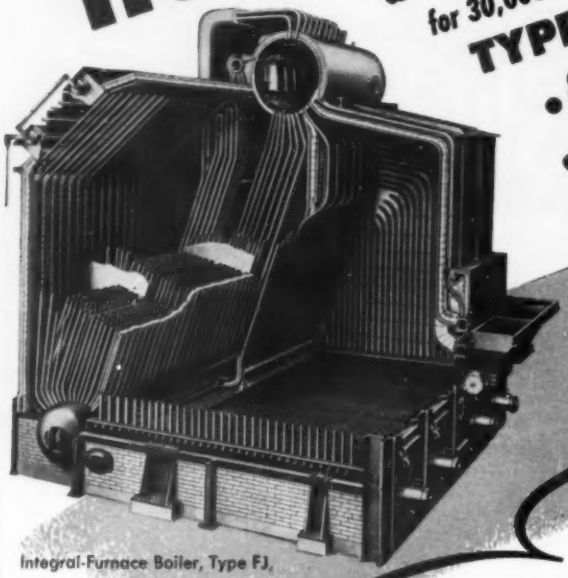
now

an integral-furnace boiler for 30,000—70,000 lb. steam per hr.

TYPE FJ SAVES:

- fuel
- maintenance
- space



Another Example of B&W Engineering for Economy

Integral-Furnace Boiler, Type FJ, arranged for stoker firing.

The Integral-Furnace Boiler, Type FJ is a recent addition to B&W's line of completely coordinated furnace-boiler steam-generators. It makes available a compact, highly efficient installation to answer all process, heating, or power requirements from 30,000 to 70,000 lb. per hr.

Complete fuel-flexibility — coal, oil, or gas, with a choice of alternative firing arrangements — protects the investor against radical changes in fuel prices or conditions of supply. This unit burns a wide variety of fuels — including those of inferior grades and low-temperature ash-fusion characteristics — with high heat-rate efficiency, low maintenance, and minimum stack emission.

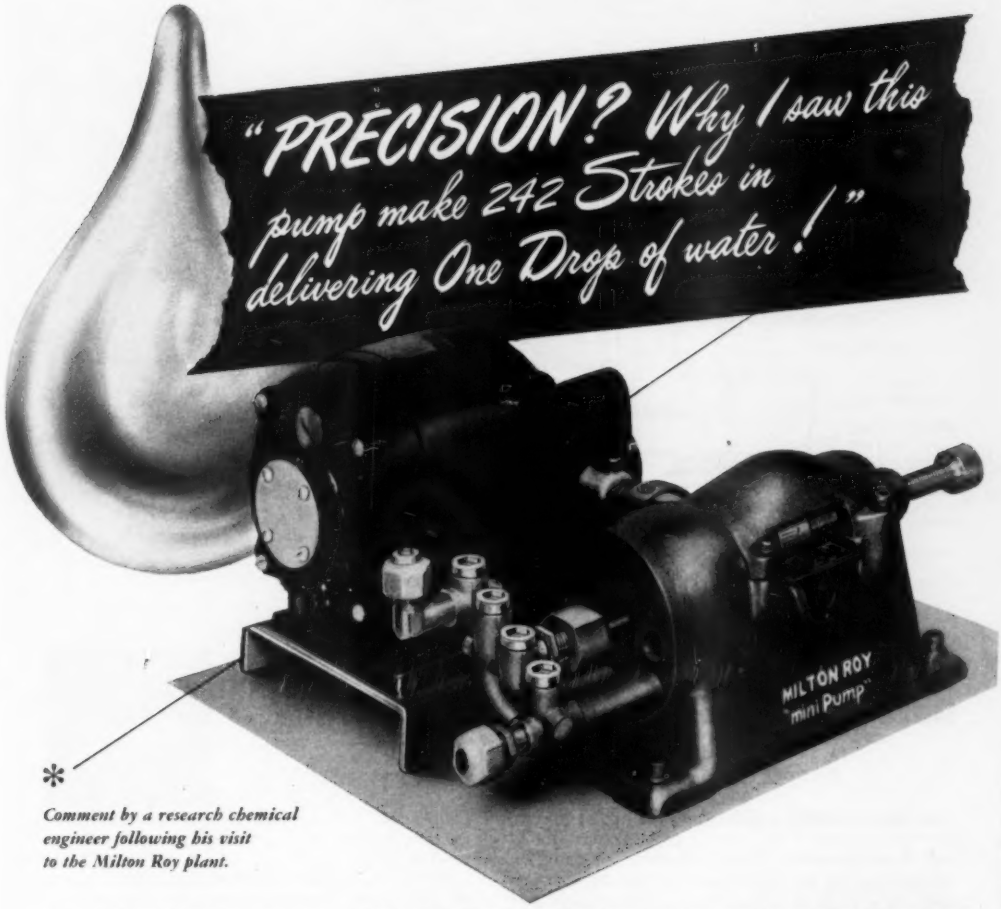
Unusually wide leeway in water-level and allowable boiler-water concentration is provided by the large drum and efficient cyclone steam separation system . . . which also contribute to ease in meeting sudden and severe load swings.

This unit incorporates all the advantages of Integral-Furnace design, which has proved so successful since its introduction by B&W in 1933. The popular Integral-Furnace "Family" now includes Types FH, FL, FJ, FF, and Shop-Assembled FM Units — spanning a range of steam-capacity now available from 2,800 to 350,000 lb. per hr.

Complete details of construction and operating advantages of the Integral-Furnace Boiler, Type FJ are included in new Bulletin G-70, available upon request from the Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

BABCOCK & WILCOX

G-542



*

Comment by a research chemical engineer following his visit to the Milton Roy plant.

. . . and what this man saw was no rigged-up "special" unit—but a standard Milton Roy Controlled Volume "miniPump", operating under normal conditions. Here are a few of the factual details:

This pump is the miniature member of the family of Milton Roy Controlled Volume Pumps—it measures less than a foot square, and weighs no more than 40 pounds—motor and all! It is available in motor-driven or air-powered types—in Simplex, Duplex, and Multiplex models. Built with watchmaker's precision, it handles any clear liquid in delivery rates ranging from 3 to 3200 milliliters per *hour* —against pressures up to 1000 psi! Its maximum speed is 100 strokes per minute—and calibrated stroke length adjustment is easily made while operating from zero to full capacity—with pump efficiency high over the entire range. The step-valve liquid-end, fully covered by Milton Roy patents, is stainless steel.

Let's consider a few uses for this dramatic little pump: in laboratory and research work; in pilot plants; in instrumentation and continuous processing; in industrial production of soaps and perfumes, food, petroleum, pulp and paper —wherever precise quantities of clear liquids in small amounts are required!

Write, *now*, for complete information to Milton Roy Company, or check your local classified telephone directory for your nearest Milton Roy representative.

WITH THE EXCLUSIVE STEP-VALVE DESIGN

MILTON Roy COMPANY

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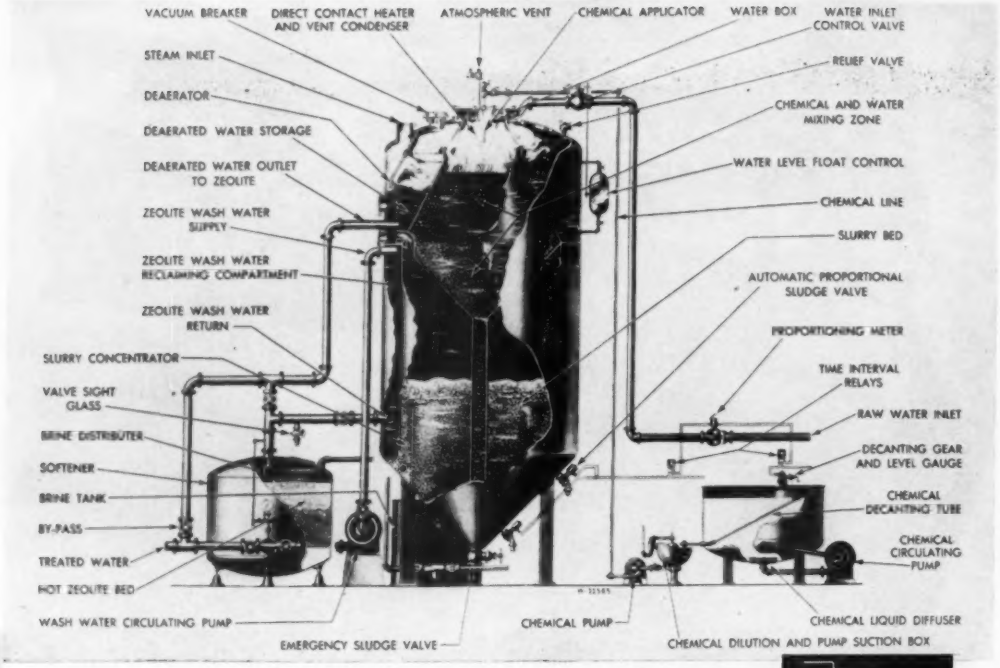
MANUFACTURERS OF CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS



Here's how to make water softening a soft job for you

You have less to do . . . to worry about . . . to pay for—when you use Worthington's revolutionary Hot-Z Slurry-Type Deaerating Water Softener.

It combines all the best features of Hot Process and Zeolite, plus these Worthington-originated features:

No more scaling trouble. Direct-contact vent condenser eliminates scaling trouble experienced with old-fashioned shell-and-tube types.

Supervision reduced. Concentrated sludge is removed automatically and proportionately to water volume.

Assures uniformity. Hydraulic chemical mixer assures uniformity of chemical strength. Also saves space.

Easier cleaning of valve-type wash water sight glass.

Better deaeration. Steam-jet deaeration is simpler, gives better efficiency—removes oxygen to .005 cc per litre.

Independent backwash system. Built-in annular wash water compartment provides clear hot water for backwashing and reclaims it without affecting operating velocities in treating zone. This feature not only pays off in systems employing filters, but also is ideal for backwashing the hot zeolite.

You also save because Worthington Hot-Z Systems operate on low-priced lime and salt. The average installation saves enough in chemical costs to pay for itself in 3 years!

Get all the facts!

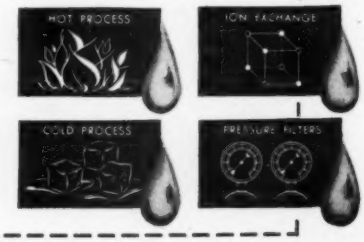
It will pay you to investigate the Worthington Hot-Z System thoroughly. Tell us your conditions of service and get our recommendation in terms of dollars and benefits. You'll find *there's more worth in Worthington.* Worthington Pump and Machinery Corporation, Water Treating Section, Dunnellen, N. J.

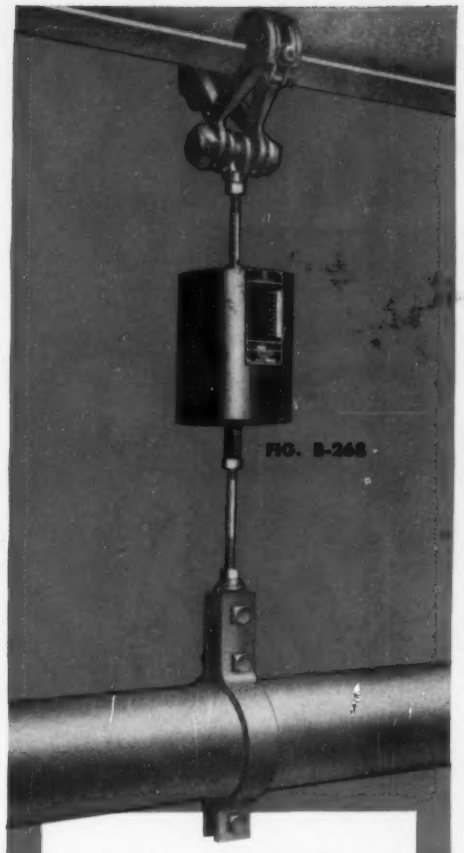
J.1.2

WORTHINGTON

WATER CONDITIONING

Worthington Makes More of the Equipment for All Types of Water Conditioning Systems





Pre-solve Pipe Suspension Problems...

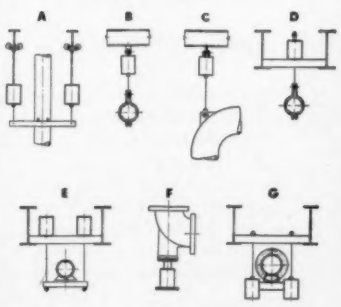
with

Grinnell Pre-engineered Spring Hangers

- Maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes.
- Precompression* assures operation of spring within its proper working range where variation in supporting force is at a minimum.
- Compact—minimum headroom made possible by precompression*.
- Guides prevent contact of coils with casing wall or hanger rod and assure continuous alignment and concentric loading of spring.
- All-steel welded construction meets pressure piping code.
- 16 sizes available from stock — load range from 74 lbs. to 9000 lbs.
- Easy selection of proper sizes from simple capacity table.
- Installation is simplified by integral load scale and travel indicators.
- Unique swivel coupling provides adjustment and eliminates turnbuckle.

**Precompression is a patented feature.*

TYPICAL APPLICATIONS



(A) Rod threaded to top cap (B) Furnished with single lug (C) Two lug style (D) Top adjusting (E) Adjustable top and bottom (F) For floor support (G) Trapeze assembly.

FOR LESS VARIATION IN SUPPORTING FORCE — FIG. 98

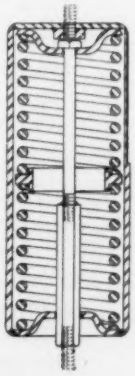


Fig. 98 is an adaptation of Grinnell's popular spring hanger, Fig. 268. It consists of two springs arranged in series within a single casing. A centering guide insures the permanent alignment of the spring assembly.

Fig. 98 has half the load deflection rate, and double the total working range of Fig. 268. Its 16 spring sizes accommodate loads from 74 lbs. to 9000 lbs. — but with a total working range *up to 5 inches!* Fig. 98 comes in the same seven types as shown for Fig. 268. Design details for identical types and sizes are the same for Fig. 98 and Fig. 268.

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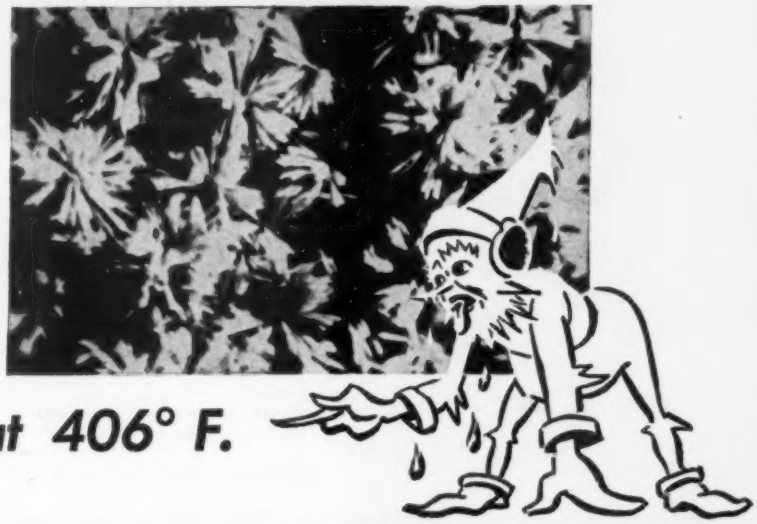
JACK FROST



at 406° F.

MAGNIFIED fifty times, the calcium carbonate scale in the photo above might easily be mistaken for a frosted window pane. It was formed at 250 p.s.i. in one of the Nalco Laboratories' test boilers as a part of the continuing Nalco research program, aimed at keeping such scales *out* of your power plant equipment.

Whether your feedwater and plant conditions produce this type of scale — or any of hundreds of others — your Nalco Representative has the proved solution for eliminating scale or corrosion from raw water inlet to and through condensate return lines . . . permanently . . . economically. Check with him today — or write direct for fast action on your water treatment problems.

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"Nalco ABSTRACTS" is a quarterly publication containing abstracts of general and technical articles of interest to power plant engineers. If you, like most of us, find too little time to read, "Nalco ABSTRACTS" can be of real help in keeping you up-to-date on current developments. Your copies will be sent free upon request.

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HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail

TRAPS, STEAM EQUIPMENT

101 Steam, Air and Gasoline Traps — Catalog 751, 32 pp, is a recently issued 32-pp ordering book on company's line of traps. It's fully illustrated and complete with capacity tables, installation diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb; expansion steam traps for pressures to 250 lb; weight-operated traps for steam, air, gasoline, pressures to 1500 lb; piston-operated steam traps for pressures to 650 lb; also separators. W. H. Nicholson & Co.

102 Trap Data — Here's a 12-pp condensed catalog giving information and prices on company's steam and air traps. Lists cast semi-steel and forged steel inverted bucket traps, compound steam traps, ball float air traps, Y-type strainers and internal check valves. Provides data on calculation of condensate loads and selection of traps to handle those loads, also a full-page capacity chart. A parts list is included for cast semi-steel and forged steel inverted bucket traps. Armstrong Machine Works.

103 Steam Trap Reference Manual — A great deal of application and selection information on steam traps is packed into 24-pp Bulletin T-1760. Tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Also provided are installation and operating suggestions, construction details, prices. Yarnall-Waring Co.

104 Using Steam Economically — Twelve-pp booklet 2171 is written in shirt-sleeve English and consists of 16 questions and answers on efficient use of steam. Not a sales catalog, this booklet covers best use of steam in process equipment, what determines process operating temperature, importance of condensate removal, right position for steam traps, use of flash steam from high pressure steam heated units, and other factors involved in steam usage. Sarco Co., Inc.

ELECTRICAL

105 Switches in Brief — Divided into sections covering different switch classifications, Condensed Bulletin 54 covers entire scope of company's 5000 snap-action switches. Catalog describes and illustrates representative models in each classification. Presents heavy duty limit, medium duty limit, explosion-proof, high capacity enclosed, die-cast enclosed, basic, VJ switches and actuators. Shows at a glance the many uses to which company engineers have applied the basic precision snap-action switching principle. Micro Switch.

106 Longer Lasting Raceways — Engineering data and installation instructions for manufacturer's Dekoron coated Electrunite E.M.T. are presented in this folder. Fully illustrated, explains how this galvanized electrical tubing, to which polyethylene has been applied, provides corrosion resistant wiring raceways for use in process industries and wherever corrosive atmospheres are present. Steel and Tubes Div., Republic Steel Corp.

107 Electrical Fittings — Catalog 120, a 70-pp reference manual, contains illustrations, ordering numbers, prices and weights of a complete line of electrical fittings. Covers conduit fittings, cable terminations, cast iron boxes, solderless connectors, power connectors and grounding devices. All information is indexed three ways — by photo, product name and catalog number. O. Z. Electrical Mfg. Co., Inc.

108 Raceway Fittings — Bulletin 65, 64-pp, lists electrical conduit and cable fittings for all types of raceways. Includes locknuts; elbows; pipe straps; conduit supports; connectors and couplings for rigid conduit, for EMT, for armored cable, for non-metallic sheathed cable and for service entrance cable; grounding equipment; service entrance fittings; floor and junction boxes; tubulets, bending tools. Products are clearly illustrated and many charts provided. Also included is related information about conduit dimensions, capacities of conductors, bolt and screw sizes. The Thomas & Betts Co., Inc.

109 Bus Duct Manual — Booklet B-4272A, 68 pp, on bus duct and accessories, presents application and test data, specifications, information on pricing an installation. Describes advantages of bus duct for a secondary power distribution system, carrying current from transformers to switchgear — and from there to motors, lighting systems etc. Company's line of bus duct and accessories is shown and dimensions of two-, three- and four-wire bus duct given. Also presented are overload protective units — circuit breaker, safety switch and cover-operated fusible switch. Includes tables and formulas useful in applying bus duct correctly, voltage drop curves for low impedance bus duct. Westinghouse Electric Corp.

110 Solderless Connectors — Bulletin 750 describes a line of splice caps and lugs for solderless splicing and terminating of electrical wires. Tells their advantages, show how they're easily installed with company's Pres-Sure-Tool. Includes detailed descriptive data ordering information. Buchanan Electrical Products Corp.

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111 Single-Phase Inductrols — Publication GEC-796 describes company's single-phase low-voltage dry-type induction voltage regulators, explaining advantages of the redesigned industrol equipment, its application and operation. Also contains sketches, line drawings and charts showing operating connections. Price and purchasing data on the new line, rated at 0.3 to 24 kva M included. General Electric Co.

112 Automatic Voltage Regulator — Bulletin S 351, 12 pp, details workings of company's automatic voltage regulator in maintaining a constant output voltage regardless of fluctuations in a-c input line voltages and changes in output load. Standard models of both instantaneous electronic and electro-mechanical types are presented. Fully illustrated with drawings and performance data. Rating chart gives engineering information needed for selection of proper unit for a specific job. Price list included. The Superior Electric Co.

113 Panelboard Planning — Twenty-pp Booklet B-5080 describes circuit breaker panelboards for the control and protection of lighting, appliances, other power applications and the circuits that supply them. Presents company's line of De-ion circuit breakers for industrial and commercial requirements, in capacities from 10 to 600 amp. Westinghouse Electric Corp.

114 Electronic Equipment Directory — Lavishly illustrated, this 1053-pp book lists products of major radio-electronic equipment manufacturers in the United States. Complete with prices and discounts, it is announced as a helpful ready-reference buying guide for this equipment. Covers condensers, resistors, transformers, potentiometers, switches, wire amplifiers, communication systems, tubes for electronic applications, test instruments, meters, batteries, selenium rectifiers, voltage regulators etc. Please give title when requesting this catalog. Milo Radio & Electronics Corp.

TOOLS, SOLDERING

115 Solder Text — Announced as the first of its kind this 36-pp book is basically an editorial treatise, well illustrated. Separate sections are devoted to thermal effects, mechanical properties, principles of soldering and fluxes. The selection of the proper solder for the job is explained, and fusible alloys are described. Practical suggestions and a comprehensive description of all of company's solders are provided, also technical data, including melting range of tin-lead solders, ASTM, SAE and other specifications, wire tables. Federated Metals Div., American Smelting and Refining Co.

116 First Aid for Pliers — If steel shortages are making it harder for you to replace broken and rusted pliers you'll welcome this little 8-pp booklet. Clearly illustrated and written in mock-medical style it tells the common ailments of pliers and gives practical remedies for putting the pliers back in working condition, keeping them that way. Utica Drop Forge & Tool Corp.

117 Screwdriver Handbook — Besides providing full ordering information, 23-pp Catalog SD-551 serves as a reference encyclopedia on screwdrivers, nutdrivers, bits and other hand tools. Book is profusely illustrated in color and punched for filing in binder. Includes a handy screw and screwdriver reference chart on inside front cover. Vaco Products Co.

INSTRUMENTS AND CONTROLS

118 Gas Dust Instrument — Now available are engineering data sheets on a gas dust analyser, recorder and alarm, an instrument designed to record amount of total suspended solids or dust particles in gas streams. Suggested applications for the instrument include blast furnace gas lines, boiler smoke stacks, process stacks. Typical charts and sampling arrangement illustrated. In looseleaf cardboard binder. General Power Plant Corp.

119 Oxygen Recorder — Bulletin 51-129, 16 pp, explains and illustrates operation of manufacturer's oxygen recorder. A large application table shows where, how and why the instrument is used, and colored illustrations show how an analysis is made. Both analyzing and recording sections are described, also gas sampling systems used with the instrument. Includes chart-illustrated discussions of results obtained in several installations. The Hays Corp.

120 Mechanical Pressure Gage — A compact instrument designed to measure mechanical pressures or compressive loads even in limited space is described and pictured in this bulletin. Design and performance features, pertinent dimensions given. Instrument capacity ranges (calibrated in pounds or kilograms) are listed along with prices. W. C. Dillon & Co., Inc.

121 D-C Dynamometers — Illustrated Bulletin GEA-5562 covers 250-v d-c dynamometers for direct connection testing of internal combustion engines, electric motors, pumps, blowers and compressors. Describes their features, applications and operation. Includes installation photos, cutaway view of a dynamometer, rating table and performance chart. General Electric Co.

122 Draft and Low Pressure Instruments — Functionally designed and fully illustrated Bulletin 51-567, discusses seven types of indicators, as well as recorders, and controllers. A large application table is included to aid in selecting correct instrument for specific conditions. Features such as calibrating springs, diaphragm units and differential valve assemblies are explained. Sizes, scales, ranges of each instrument are discussed. Also pictured are 14 types of measuring elements. The Hays Corp.

123 Temperature Conversion Chart — Here's an easy reference chart for use in converting temperatures from −70 to 6500 deg. either Fahrenheit or Centigrade. It's printed in two colors on stiff plasticized board, and 3-hole punched for use in binders. Reverse side lists major types of company's thermostats, their applications and general performance characteristics. Stevens Mfg. Co., Inc.

VALVES, PIPING ACCESSORIES

124 Valves, Specialties — Six-pp Bulletin W-350-B5C describes and illustrates gate and needle valves, flanges, hose nipple, bars, welding electrodes and screw machine products manufactured of company's Worthite. Lists corrosive solutions Worthite valves are designed to handle. Worthington Pump and Machinery Corp.

125 Valves for Processing — General Catalog 1500 B, 20 pp, describes in detail the operation and performance of all of company's single seated valves — the

(Continued on page 182)

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From Any Raw Water Supply

The AMBERLITE deionization process gives you the water you *need* from the water you *have*. Regardless of water analysis, you can obtain highest quality boiler-feed water, *without* evaporation. Total ionized solids can be reduced to less than 0.1 p.p.m. Silica content, CO_2 content and hardness are virtually zero.

You'll cut costs, too, with AMBERLITE deionization. Equipment cost is small compared to evaporators. Operating cost is lower. Corrosion of piping is reduced through removal of CO_2, which is never completely accomplished by evaporation. An adequate supply of conditioned water is assured despite wide variation in the quantity required.

For improved water conditioning at lower cost, choose either an AMBERLITE multiple bed installation or a single bed unit. For further details, write today for your copy of our new four-page bulletin on AMBERLITE Ion Exchange Resins. Then discuss AMBERLITE deionization with your consulting engineer or water conditioning equipment manufacturer. He will be glad to help you select the right combination to suit your specific needs.

Newest word in water-treating

MONOBED DEIONIZATION

One pass through one column of AMBERLITE mixed anion and cation exchangers can transform raw water into deionized, silica-free water. Ask for our new 12-page booklet, "Monobed Deionization."

AMBERLITE *is a trade-mark, Reg. U. S. Pat. Off. and in principal foreign countries.*

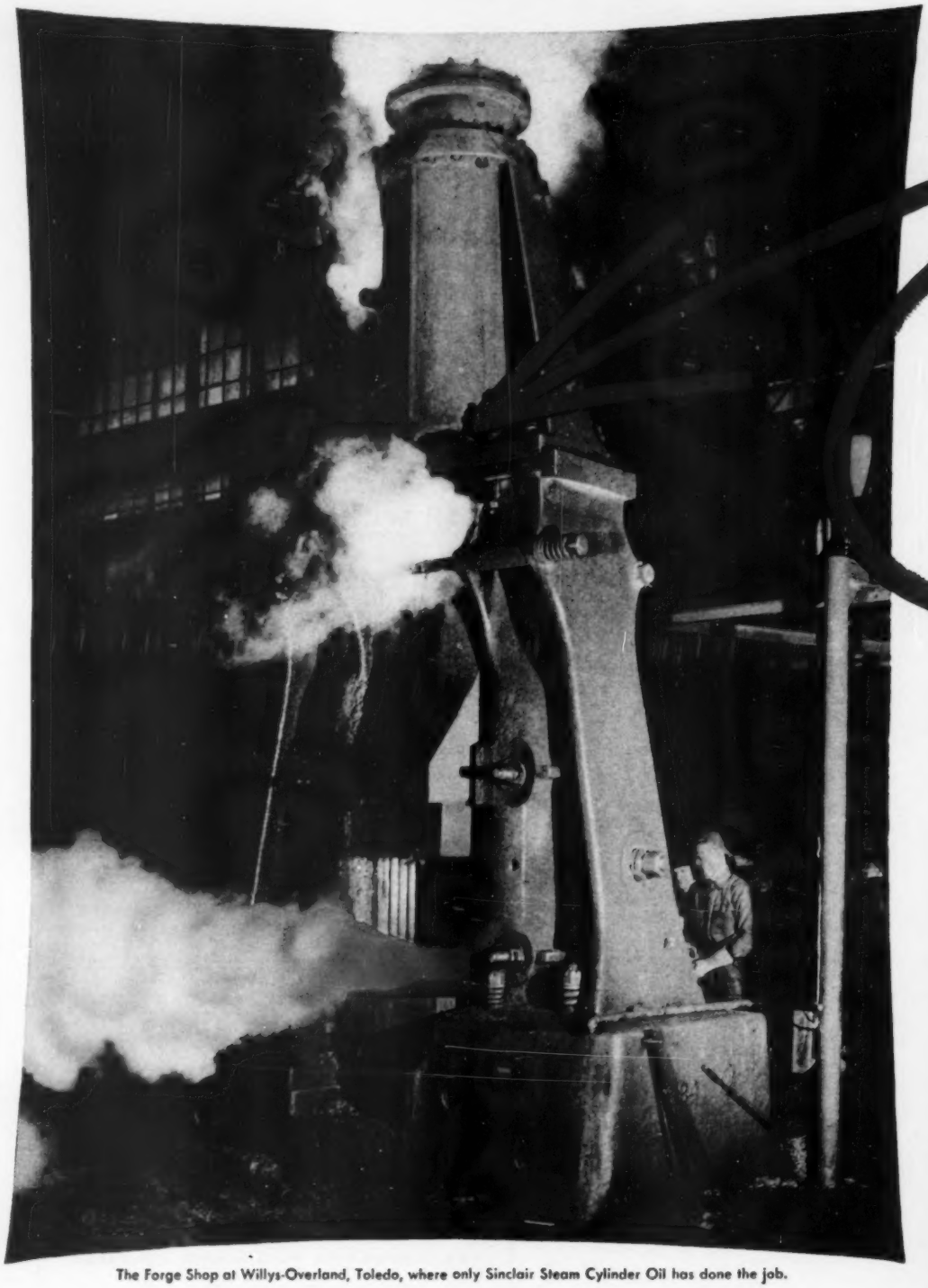
CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square Philadelphia 5, Pa.

Representatives in principal foreign countries



The Forge Shop at Willys-Overland, Toledo, where only Sinclair Steam Cylinder Oil has done the job.

"NO OTHER OIL has done this Job!"

reports Willys-Overland Forge

Mr. Wm. Paris, Vice President in Charge of Manufacturing at Willys-Overland Motors, Inc. says, "We have saved plenty of cylinders, packing, and down-time since shifting to Sinclair lubrication."

Rising production forced the mammoth Forge Shop at Willys-Overland to step up ram speed 30%. As the power was insufficient, the steam had to be raised to 400°F. by superheating. Then the lubrication problem started!

The hotter steam and faster ram speed quickly burned up packings, and cylinders became scored. Many lubricants were tried. All failed to halt the destruction... until the Forge tried Sinclair Valve Oil Light. Now it reports it hardly ever has a scored cylinder and no more lubrication headaches. The Forge does not believe it possible to get finer steam cylinder lubrication and emphatically concludes that, "No other oil has done this job!"

If you have a steam cylinder lubrication problem it can pay you to consult with Sinclair, for Sinclair makes a wide variety of Steam Cylinder Oils to handle every possible need. Get in touch with your nearest Sinclair Representative or write Sinclair Refining Company, 600 Fifth Ave., New York 20, N. Y.

SINCLAIR STEAM CYLINDER OILS

for every steam cylinder installation

NEW EQUIPMENT NEWS

WHAT'S NEW? On these pages the Editors summarize the outstanding industrial developments of leading manufacturers who will supply you, free of charge, the bulletins or other information desired. For ease in making requests use the non-obligation, postage-paid card pages 37–38.

1—ELECTRICAL TAPE

Made with Koroseal material features non-transferring adhesive

This tape can be pressed onto a dry surface innumerable times without losing its stickiness because the adhesive is non-transferring. It is also said to stick snugly and securely to itself and to insulation around copper wire. Dielectric strength of the tape is given as 8000 v. It is flameproof and waterproof, according to manufacturer, and resistant to abrasion, acids, oil, alkalies and corrosive salts.

Because it is extra thin it takes up less room in junction boxes. It's packaged in rolls 60 ft long and is ¾ in. wide, 0.007 in. thick. Each roll comes in a metal container and a special carton holds 12 containers. The B. F. Goodrich Co.

2—CONVEYOR BELT CLEANER

Spring type, is adaptable to existing conveyor installations

Although not previously publicized the S-A Spring Type Conveyor Belt Cleaner has been used successfully on conveyor installations for several years, according to manufacturer, and it's reported to be a most effective method of cleaning belts. Self aligning, spring steel wiper blades set perpendicular to belt surface, but diagonal to belt travel, wipe the belt clean and dry as it passes. Spring arms supporting the blades maintain a uniform pressure on the belt and let the blades ride easily over splices. Dribble from the cleaner falls directly into the rear of the discharge chute.

Since the wiper has an independent mounting assembly it can be adapted to fit existing installations. Adjustments and replacements can be made from either side without interrupting conveyor operation. Stephens-Adamson Mfg. Co.

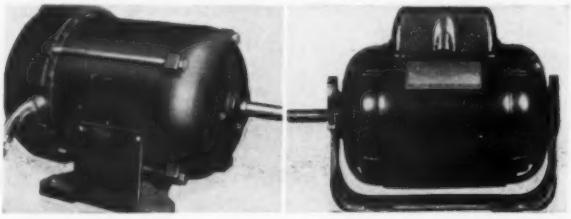
3—CAPACITOR MOTORS

Totally enclosed and fan cooled, or with resilient-base construction

To extend advantages of company's Tri-Clad line of single-phase capacitor motors to special applications, this manufacturer now offers these new models. The enclosed one, pictured at left, was developed for use where extra severe conditions of dirt, grit or moisture are encountered. It's also offered in explosionproof and dust-explosionproof construction for hazardous conditions. Features of the new design include starting capacitors and switch mounted within the frame, and it's available in ratings of 1, 1½, 2, 3 and 5 hp. Typical applications include coal stokers, exhaust fans and fuel pumps.

The new single-phase capacitor induction motor with resilient base is designed for use where freedom from vibration and extra quiet operation are required. This construction is available on motors rated from ½ to 5 hp. According to manufacturer, all single-phase motors have some torque pulsation, but the resilient base isolates this vibration so it is not transmitted to the driven machine. This motor has an enclosed built-in-transfer switch.

Both styles feature cast-iron construction and the Tri-Clad protection against physical damage, electrical breakdown and operating wear. Small and Medium Motor Divs., General Electric Co.



4—EXTINGUISHING SYSTEMS

Mechanical foam type, for combatting flammable liquid fires

Mechanical foam systems are now available for use where flammable liquids are stored. Operation of a mechanical foam system depends on normal plant water pressure to draw, mix and deliver the fire extinguishing agent, manufacturer points out, and in large installations where main pressures would be inadequate, special pumping may be required.

The components of foam are water, foam liquid, and air. The basic mechanical foam system starts with water under pressure passing through pipes or hoses. The water velocity creates a vacuum which draws the proper amount of foam liquid from its storage chamber into the stream. Further along, a second vacuum is created which pulls air into the water-foam solution. Then it is "mixed" to create a fire-killing foam, and discharged over the burning liquid from manually controlled hoses or fixed units. Walter Kidde & Co., Inc.

5—VOLTAGE REGULATOR

Is 16-step, pole type for use on rural suburban lines or substations

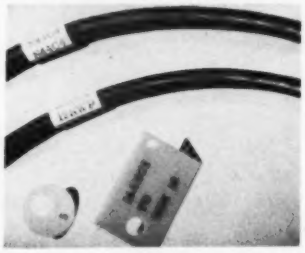
Providing ± 10 per cent regulation in sixteen 1¼ per cent steps, the Type URL-16 Feeder Voltage Regulator is intended for applications in which the 10 per cent range of company's Type URL-8 is not sufficient. The new regulator is available in ratings from 12.5 to 76.2 kva single phase and at standard voltages of 7620 and below.

The simple tap changer, with direct motor drive is oil immersed and a reversing switch provides the 10 per cent regulation on either side of the regulator neutral position. The URL-16 is equipped with company's CJ-1 package control relay which can be removed as a unit for repair or test. Westinghouse Electric Corp.

6—PERMANENT MARKERS

For wire or cable, are made of Vinylite plastic rigid sheet

Available in either flat or sleeve type, these plastic markers also have an overlay of clear Vinylite plastic to protect the lettering. They're announced as resistant to abrasion, water, oil, gasoline, alcohol and most acids and as both fungus proof and vermin proof.



Sleeve-type markers from 1/16 to 3 in. dia slip tightly over wire or cable of any shape in cross section. Any type of identification as well as color banding can be printed on the marker. Flat-type markers can be had in any size, shape or thickness, with holes punched as required. Tools for slipping on the sleeve markers are available, and there's also a threading device for looping cord through holes in flat-type markers. Bakelite Co., Div., Union Carbide and Carbon Corp.

7—MINIATURE NOISE METER

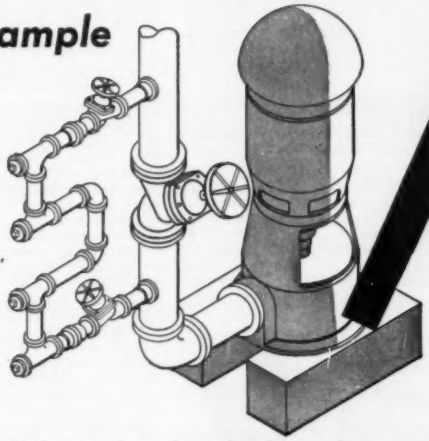
Is compact instrument featuring subminiature tubes and components

The improved Type 410-B Sound Level Meter measures noise, sound and vibration which often have harmful effects on human nerves, efficiency and hearing. It's described as accurate and rugged, and offering greater low frequency range, electrical circuit improvements and mechanical design improvements.

for outstanding service

on Corrosive Well Water

...for example



The Installation—
Barr Rubber Products Co.,
Sandusky, Ohio

PROBLEM: To eliminate costly seating and packing maintenance, and frequent replacement of valves on plant well-water pump. Valves previously used highly unsatisfactory, having maximum life of 6 months.

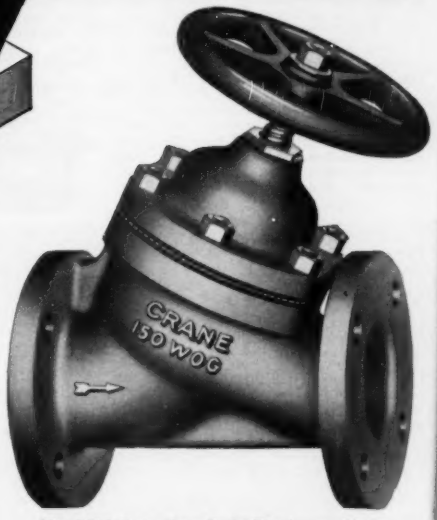
WORKING CONDITIONS: Sulphur content of water extremely high. Valve constantly exposed to severe corrosive and erosive effects. Operated infrequently; yet easy operation, positive seating are prime requisites.

SOLUTION TO PROBLEM: Crane Packless Iron Body Diaphragm Valves featuring separate disc and diaphragm design. Three-inch No. 1611 flanged end valve on main discharge; ¾-inch No. 1610 screwed end valves on by-pass.

RESULT: While other valves lasted only 6 months or less, Crane Diaphragm Valves show no effects of service, after more than a year. They operate smoothly . . . seat tightly . . . no maintenance whatsoever needed to date!

Another typical demonstration of superior quality, and the low-cost performance of Crane Valves. That's why . . . More CRANE VALVES are used than any other make!

...Choose Dependable CRANE VALVES



No. 1611 Crane Iron Body Diaphragm Valve —one of a full line suited for many services. Literature on request from your Crane Branch or Crane Wholesaler.

CRANE CO.

General Offices:
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

The sound-level range is from 34 to 140 db above standard ASA reference level of 0.0002 dynes per sq centimeter, according to company. Hearing-aid batteries used with it have an operating life of about 50 hr. Hermon Hosmer Scott, Inc.

8—LOW COST PURIFIERS

Internal type, for use in steam drums, flash tanks, evaporators

The Hi-eF Purifier is a new low cost unit designed to deliver vapor with 1.0 ppm or less of total solids. Manufacturer says it pays for itself quickly in benefits afforded by cleaner steam — in the case of steam from boilers, clean steam means longer life for reciprocating engines and turbines and longer tube life.

The improved design provides for a self-cleaning action and eliminates need for baffling in boilers and drums. Other advantages cited are low pressure drop through the unit and minimum space occupied inside a drum. Available in a complete range of sizes in fabricated steel, stainless steels and other alloys. Steam Specialty Div., The V. D. Anderson Co.

9—SMALL PIPE MACHINE

Is equipped with safety switch lock for added protection

This is company's well-known Model E, lightweight, economy machine, and the addition of the safety switch lock gives it the same safety advantages of company's larger and more expensive models. The Power Units C1 and C2 are also protected with safety switch locks.

This device is intended to protect both men and machine against possible injury. It is designed to work automatically, to make it impossible to start the machine unless the chuck wrench has been removed from the chuck and placed in its holder. This feature replaces the old-style "wrench ejector" that ejected only special types of wrenches. Now, no special wrench is required. Beaver Pipe Tools, Inc., Warren, O.

10—STEAM GENERATOR

Offers low installation cost, automatic operation, fast steaming

The Model 4740 Steam Generator widely used to supply high-pressure dry steam to heat diesel powered passenger trains, is now being used to supply processing steam to operate laundries, to supply 600 lb pressure steam for melting paraffin in pipes from portable rigs for distilling sea water and for a wide range of other applications.

For its size and weight this unit is a powerful steam generator, manufacturer points out; it develops 200 lb of steam in 2 min from 50 F water and produces 48 lb of 99 per cent dry steam per hour. It uses No. 2 fuel oil and in operation the hot gases produced wipe over the 702 ft of steel coil, turning water pumped through the coil into steam. One electric motor (gasoline engine or portable units) drives the water pump, fuel pump, blower and magneto. Once the switch is turned the automatic controls cause the machine to turn on and off as needed.

Besides its other advantages this generator offers increased safety, company says; it can't blow up because no reservoir of water is heated under pressure. Vapor Heating Corp.

11—WALL MOUNTING REEL

For easier and more efficient handling of heavy electrical cable

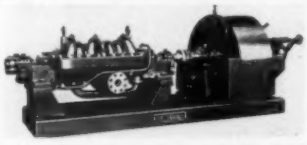
Although different in many ways from company's Port-O-Reel for handling small extension cords, the new Powereel is said to offer the same advantages — saving time and labor and reducing cable wear. It was developed to meet the need for a better way to handle or transport cable having a stationary application.

The Powereel has a special mounting flange on the side so it can be fastened to a base by the use of four ⅜ in. bolts. This flange is threaded to fit a 1 in. iron conduit or afford a water-tight connection for flexible feeder cables. While the size of the cable governs the amount which can be wound onto the reel, the new model accommodates sizes up to No. 4 four-conductor cable. A collector ring assembly is provided to prevent interruption in current during winding or unwinding of cable. Industrial Electrical Works.

12—MULTI-STAGE PUMPS

Opposed-impeller type for medium pressure, temperature service

These new pumps in company's Oppeller line included 4-, 6- and 8-stage units and are for service to approximately 1000 gpm and 1200 psi for temperatures to 350 to 400 F. They are described as especially well suited to boiler feed service, oil refinery services for handling liquids from propane to strong caustic, and for general water services.



The pump has a horizontally split casing with suction and discharge nozzles on opposite sides of the lower half of the casing. Impellers are mounted back to back to balance axial thrust and volutes are staggered 180 deg to balance radial thrust. De Laval Steam Turbine Company.

13—DRY-TYPE TRANSFORMERS

With Class B insulation, are smaller in size, lighter in weight

For single-phase 60-cycle operation, this new design provides smaller transformers at an average weight reduction of 30 per cent throughout the line and some models of these general purpose dry-type transformers weigh less than half as much as the units they replace.

Size and weight reductions are credited to the use of improved core steels and increased amounts of inorganic insulating materials. The insulation withstands higher temperatures in the copper winding, company explains, an 80 C rise over a 40 C ambient, and the corisil core (a grain oriented cold-rolled silicon steel) provides comparable losses at higher flux densities. The net result is less copper and steel per kva of output. Certain ratings are now available; the line ultimately will consist of about 50 models in ratings of 3 kva and upwards. Specialty Transformer and Ballast Divs., General Electric Co.

14—ANTI-RUST PAINT

For interior and exterior use, can be applied over rusted surfaces

PCA-100 is a penetrating and sealing anti-rust paint reported to be equally effective in preventing rust on new metal or stopping rust action on present rusted metal. Manufacturer says it can be applied right over rust without extensive surface preparation. Upon application it penetrates through the rust layer into the base metal to seal the surface against further rusting. It may be applied by brush or spray.

PCA-100 is furnished in black only, and because of its penetrating characteristics is recommended only as a finish coat. A companion product, PCA-101, is a clear paint claimed equally effective for rust prevention, which can be painted over with any standard color. Both paints come in 1- and 5-gal cans and 55-gal drums. Paint Corp. of America.

15—ILLUMINATION CONTROL

Is plug-in automatic type, in weather resistant glass case

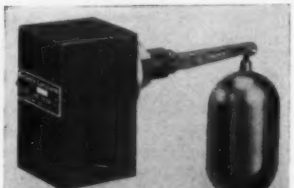
The Model 1089 is designed to provide completely automatic "on-off" control of artificial lighting at predetermined light levels, eliminating human judgment and arbitrary time schedules. It is mounted in a standard watt-hour meter glass case. Installing it requires only plugging it into a standard watt-hour meter receptacle. It is claimed to withstand adverse climactic conditions and to function at temperatures to 140 F and −30 F.

The unit consists of a stable dry-disc type photocell, a sensitive relay operated by the photocell, a clock motor, mercury switch and limit switch. It requires no stand-by power, draws no current between on and off operations, company points out, and it's economical to operate and maintain. Weston Electrical Instrument Corp.

16—SIGNAL SWITCH

Is float-operated; designed for pressures from vacuum to 450 lb

The Levalarm EA-10 is announced as heavier than the previous unit from which it was developed, and featuring improved construction. As a signal switch it is used to set off bells, sirens or lights when liquid levels in small boilers

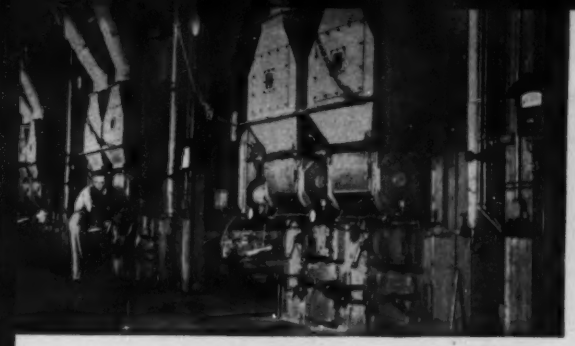


or tanks reach predetermined low or high points. Or it can be used as a fuel cut-off for low water. In conjunction with water columns, the float lever is inserted into the alarm valve opening. The Reliance Gauge Column Co.

17—TEMPERATURE EQUIPMENT

For power transformer windings, includes indicators, relay

This new line of winding temperature equipment consists of company's Hot-spot Indicator-Relay and two Hotspot



TO GENERATE STEAM for manufacturing, Triangle Conduit and Cable uses three 350 hp boilers. Each unit generates 22,500 pounds per hour, 24 hours a day, 5 days a week. *Sun Solnus Oil* lubricates the spreader stoker oil bath, *Sun 844 Grease* the pulley drive, stoker motor and pillow block.

TO CONTROL THE AMOUNT OF AIR entering the fire box, three forced draft fans are kept in constant operation. The motor and fan bearings and the speed reducer motor are lubricated with *Sun 844 Grease*, while the gears and reducers are protected by a *Sun* gear oil.

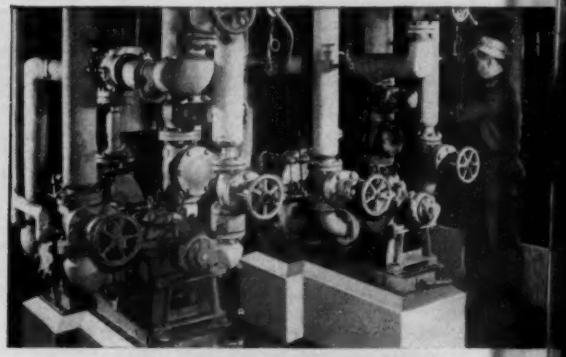
MODERN POWERHOUSE ENTIRELY SUN-LUBRICATED

Triangle Conduit and Cable produces flexible and rigid electrical conduit and cable. Its modern powerhouse generates steam for galvanizing pipe and for heating the factory, the pickling vats and the enamel paint vats prior to dipping the pipes. From the very beginning of operations more than two years ago, Sun oils and greases have been used exclusively in all the equipment, and there hasn't been a single failure because of faulty lubrication.

This modern powerhouse is wholly lubricated by Sun "Job Proved" products and the factory partly so. In both, Sun's engineering know-how has effected purchasing and inventory economies through multiple use of a minimum number of oils and greases.

For technical assistance or a copy of the manual "Lubrication of Industrial Machinery," write on your business letterhead to Department PN-9.

TO HELP GET PROPER COMBUSTION in the boilers, three exhaust fans are used. The turbine which drives them turns up 3,600 rpm. The engineer says the lubricant, *Sunvis 951*, looks like new when it is changed to get rid of condensate.



TO FEED WATER TO THE BOILERS, two 3,500 rpm turbine-driven pumps are employed. A motor-driven pump is used in starting up when there is no steam pressure. *Sunvis 951* lubricates the turbines, *Sun 844 Grease* the pump fittings.

SUN INDUSTRIAL PRODUCTS

SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

SUNOCO®

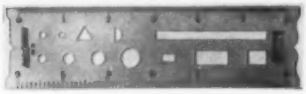
Indicators, one for local indication and one for remote indication. The indicator-relay is described as the first device of its kind to provide, in one unit, accurate indication of hot spot temperature as well as automatic starting of cooling fans, oil pumps, alarms or any other circuit in desired sequence and at a predetermined hot spot temperature.

All of the new equipments can be removed and tested without de-energizing the transformer, lowering the oil level or interfering with transformer operation, states manufacturer. The units are interchangeable between any transformers having these new devices and are hermetically sealed. They're installed in a liquid-tight well in the side of the transformer tanks just below the minimum liquid level. Transformer and Allied Product Divs., General Electric Co.

18—SKETCH SCALE

Is transparent pocket rule with cut outs for making drawings

Described as a non-technical instrument of technical quality, the No. 20 Sketch Scale is a time-saver for field sketches.

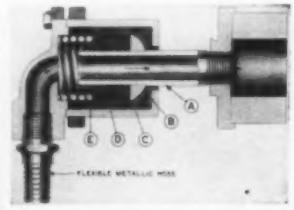


It's made of 0.030 matte finish plastic, scaled in 10ths and 16ths, and costs 50 cents. RapiDesign, Inc.

19—ROTARY PRESSURE JOINTS

Self-supporting, in heavy duty construction for pressures to 250 lb

These rotary pressure joints have been added to manufacturer's Type S line to extend their use to applications involving higher operating temperatures. The



Type S was developed to combat the threat of misalignment for service on machines where considerable lateral movement of rolls is encountered. Johnson Corp.

20—POWER SUPPLY

Voltage regulated; has low ripple content, low output impedance

The high voltage supply provided by the Model 1250 is continuously variable from 200–1000 v and delivers from 0 to 500 ma. In the 200 to 1000 v range the output voltage variation is said to be less than ½ per cent for line fluctuations from 105 to 125 v and less than ½ per cent for load variation from 0 to 500 ma. Ripple is given as less than 20 mv.

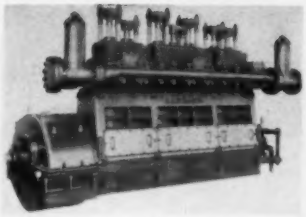
This power supply includes input and output fuses on the front panel, a time delay relay and an overload relay. Kepco Laboratories, Inc.

21—DIRECT FLOW PUMPS

With 6-in. stroke; available in 3-, 5-, 7- and 9-plunger units

Ranging from 300 to 900 hp, these 6-in. stroke pumps are suggested for such applications as chemical handling, heavy forging press service, water injection, steel mill descaling. They operate at crankshaft speeds to 300 rpm and are suitable for direct drive by engine or synchronous engine-type motor.

The pumps feature inverted design and a direct flow fluid-end. All wearing parts are interchangeable among 3-, 5-, 7- and 9-plunger units. The fluid-end is sectionalized to simplify maintenance.



Changes in plunger size can be made to meet alterations in pressure or capacity. The Aldrich Pump Co.

CATALOG LIBRARY

This monthly list of the latest standard catalogs and bulletins is designed to aid the engineer in maintaining his permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the bulletins. Use the Helpful Bulletins coupon in requesting these copies.

VALVES, TRAPS, PIPING

201 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blower, water column blow-down, and other types of pipe line. Includes dimensions, weights; prices. Everlasting Valve Co.

202 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special construction features and other advantages. E. M. Dart Mfg. Co.

203 Blow-Off Valves — Illustrated Bulletin B-433, 24 pp, describes blow-off valves for high-pressure boilers, and covers seatless, hard-seat and unit-tandem types, for working steam pressures from 400 to 2500 lb. Construction details and operating principles are illustrated. Dimensions and specifications included. Yarnall-Waring Co.

204 Popular Steel Valves — Condensed Catalog 104, 28 pp, describes and illustrates most widely used of company's cast and forged steel valves and the data presented for these valves is complete. Those listed are chiefly in the basic steam pressure classes — 150 to 2500 lb — and include globe and angle, gage, instrument, hydraulic and relief types, also strainers, and check, gate, non-return and blow-off valves. Explains design features, gives construction details, ratings, specifications. Edward Valves, Inc.

205 Valves, Fittings and Flanges — Catalog F-9 is a 400-pp, permanently bound reference book on drop forged steel valves, fittings and flanges for practically all piping needs at high and low pressures and temperatures. Provides not only ordering information on company's complete line, but also much helpful engineering and application data, and includes a section on products for refrigeration service. Fully illustrated, well-indexed. Available to qualified power engineers, please give your title. Henry Vogt Machine Co.

206 Piping Pointers — This is a new 36-pp edition of company's highly popular piping manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains many illustrated how-to-do-it features. Included with manual is an 8-pp valve selection guide. Crane Co.

207 Valve Specialties — Included in 90-pp Catalog A-50 is complete ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas, water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves, pilot valves; back pressure, relief and non-return valves, steam trap and air vent; liquid level controllers; solenoid valves. Includes capacity charts. Davis Regulator Co.

208 Pressure Reducing Valves — Selection and engineering data on pressure reducing valves, including those for remote control of reduced steam or water pressures, are presented in 12-pp Bulletin 477-A. Northern Equipment Co.

209 Steam Traps and Temperature Controls — Here is a comprehensive catalog comprising many of company's bulletins on steam traps and related equipment, including an illustrated steam trap selection chart. Provides data on boiler steam traps, air eliminators, thermostatic steam traps and air vents, inverted bucket steam traps, temperature regulators and cooling controls, steam and water mixers, thermostats and strainers. Sarco Co., Inc.

210 Steam, Air, Gasoline Traps — This 32-pp illustrated catalog, No. 250, describes five types of thermostatic steam traps for pressures to 225 lb; expansion steam traps for pressures to 250 lb; weight-operated traps for steam, air and gasoline service, pressures to 1500 lb; piston-operated steam traps for pressures to 650 lb, and also steam, air and gas separators. Includes capacity tables. W. H. Nicholson & Co.

211 Handbook on Fittings and Flanges Catalog wf-1950, 88 pp, is packed with working information on seamless carbon steel welding fittings and forged steel flanges. In addition to presenting standard schedules with their specifications, list prices and sizes, book gives information on dimensional tolerances; American standard flange facings with dimensions; thread standards and threading practice; service pressure ratings, physical and chemical requirements for flanges, nuts and bolts; plus sizes and wall thicknesses of welding fittings in other metals. Grinnell Co., Inc.

212 How to Choose and Use Air Traps — Bulletin 202, 4 pp, describes a line line of air traps, covering their selection and installation for automatic drainage of moisture from compressed air intercoolers, aftercoolers, receivers, separators, drip points. Prices included. Armstrong Machine Works.

213 Safety Valve Engineering Data — How company's safety valve works and its important operating advantages are explained in Bulletin 707, 4 pp. Includes dimensions on flanged and welded inlet valve types, tables on superheat correction factor, capacities. Manning, Maxwell & Moore, Inc.

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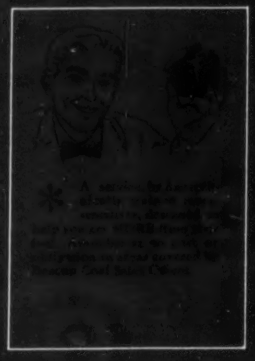
what **fuel to use**

perhaps **Beacon Combustion Service**

can give you the answer information



EASTERN GAS AND FUEL ASSOCIATES

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NORFOLK PHILADELPHIA SYRACUSE

For New England: New England Coal & Coke Co., *For Export:* Castner, Curran & Bullitt, Inc.

214 High-Pressure Gate Valve — Described in 4-pp Form DH-273 is a forged steel gate valve designed for long service and low cost maintenance. Working pressures, sizes and prices listed. R-P & C Valve Div., American Chain & Cable Co., Inc.

215 Strainers and Separators — Bulletin R-46-50A is a 16-pp catalog on T-type strainers, suction strainers, multiflow and receiver separators. Contains dimensions, weights, prices. Shows how several types have been redesigned for increased efficiency. Dimensions, service pressure ratings. American District Steam Co.

ELECTRICAL

216 The Why of Dry Type Transformers — Booklet B-4428, 24 pp, discusses reasons why dry-type transformers are safer and less expensive to install and maintain in industrial plants and utilities. Types of air-cooled transformers for every use are illustrated from small ones for operation of intercommunication systems to power centers as large as 10,000 kva. Also describes sealed, submersible, dry-type transformers. Westinghouse Electric Corp.

217 Power Factor Correction — Examples showing basic considerations in the improvement of system power factor are contained in Bulletin 05B7465, 4 pp. Points out economical and operational advantages of improving plant power factor and advisability of keeping the load power factor up to 0.8 lagging or higher; tells how the effects of low power factor can be corrected. Allis-Chalmers Mfg. Co.

218 Synchronous Motors — High speed synchronous motors are described in 4-pp bulletin PB 5600-1. The bulletin is packed with descriptive matter and photographs explaining features. Elliott Co.

219 Care of A-C Rotating Equipment — To promote intelligent and consistent maintenance of electrical machines, company has published Bulletin 05R7417, which is a series of articles by Fraser Jeffrey. Contents of the 24-pp booklet cover preventive maintenance and machine repairs, and such subjects as drying moist insulation, measuring insulation resistance. Allis-Chalmers Mfg. Co.

220 Buyers' Manual on Motors and Control — Fifty-pp Catalog GEC-1009 presents buying information on a carefully selected group of motors, motor starters, control accessories and electronic control. Ratings listed are those most frequently required. Excellent data on proper selection is provided as well as dimensions, ratings, prices. Illustrated. General Electric Co.

PUMPS AND COMPRESSORS

221 Compressor Selection Chart — Here's a chart, based on normal applications handling air with atmospheric intake pressure. It simplifies selection of proper size compressor, giving quick comparison between discharge pressure pounds per square inch gage and piston displacement cubic feet per minute and shows recommended compressor bore and stroke in inches. Worthington Pump and Machinery Corp.

222 Boiler Feed Pumps — Bulletin 109, 16 pp, illustrated in color, describes detail centrifugal pumps for boiler feed service. Explains and pictures construction and major parts, explaining in detail the floating seal incorporated. Capacity data is provided, vapor pressure tables. Pacific Pumps, Inc.

223 Pulsation-Free Compressor Piping — Illustrated Bulletin PDS-8501, 4 pp, describes company's pulsation dampening piping system. Tells how this piping compares in first cost to other piping, but affords higher operating efficiency, other advantages. Explains pulsation phenomena in gas compression systems and how dampening principle is applied. The Fluor Corp., Ltd.

224 Data on Pumps — All Types — Bulletins are available on centrifugal, reciprocating, screw and rotary pumps covering a wide range of capacities and services. Includes information on single and multi-stage, close coupled, single and duplex piston, and special pumps for handling erosive and corrosive liquids, also high viscosity liquids, both lubricating, non-lubricating. Warren Steam Pump Co., Inc.

BOILERS AND AUXILIARIES

225 Steam Boilers — Form SG 128-749 is a 12 pp, four-color catalog generously illustrated with photos of steam boilers for processing and heating, ranging from 15 to 500 hp and 15 to 200 psi. Includes a diagrammatic cross-section showing the four pass design characteristic of manufacturer's boilers. Cleaver-Brooks Co.

226 Re-Circulation Steam Generator — Here's a 6-pp folder introducing a controlled re-circulation steam generator, describing its development and recommended uses, such as applications where steam is required in remote locations, where demands are intermittent or load fluctuating. Illustrated, text explains operation, features. Combustion Engineering-Superheater, Inc.

227 Packaged Generators — Bulletin SB-38 introduces company's new Keystone model. Photos and sketches show complete unit, pressure element and details of its compact design. Gives advantages of two-drum water boiler, three-pass gas travel, automatic gas or oil burner. Dimensions, capacities. Erie City Iron Works.

228 Shop-Assembled Boiler — Eight-pp Bulletin G-72 introduces company's new integral furnace boiler. Describes and illustrates its economy, ease of installation and connection, flexibility, minimum space requirements, efficient combustion, fast steaming. The Babcock and Wilcox Co.

229 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm so as to provide dependable operation at maximum temperatures. The Wickes Boiler Co.

230 Tube Expanders — Bulletin 380, 8 pp, covers manufacturer's line of tube expanders for maintenance of high pressure boiler tubes, superheaters, economizers, circulating tubes, steam generators, other equipment. Thomas C. Wilson, Inc.

231 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads, discussing special features. Also includes data on motors, hose. Roto Div., Elliott Co.

232 Streamlined Baffle Walls — Bulletin BW-44, 20 pp, describes company's baffle walls, showing their application to modern boilers and for modernizing existing units. Fully illustrated with photos and drawings covering installations, remodeling designs. The Engineer Co.

233 Air Preheaters — Illustrated Bulletin A-11610, 8 pp, defines air preheat and explains its benefits in terms of increased efficiency and capacity and flame stability. Provides general description of company's preheater, discusses its application to boiler plants. The Air Preheater Corp.

234 Soot Blower Head — Illustrated Bulletin 485, 4 pp, describes a new rotary soot blower head for improved boiler cleaning. Explains how blower head is designed to give maximum blowing pressure through the full blowing arc, is rugged, easily serviced, economical. Vulcan Soot Blower Div., Continental Foundry & Machine Co.

INSTRUMENTS AND CONTROLS

235 For Centralized Control — Bulletin 109, 4 pp, presents the new, compact Mini-Line equipment suited to control board arrangement which concentrates vital operating information and controls for one or more boilers, turbines or process units before a single operator. Describes and illustrates vertical-scale indicator units, selector valve, remote manual relay. Bailey Meter Company.

236 Remote Reading Flow Meters — Data Book 702, 32 pp, fully illustrates and explains flow measurement problems and offers suggestions for their solution. Meter bodies, differential devices and reading instruments are fully described. Republic Flow Meters Co.

237 Flow Meters — Bulletin 400-F2, 8 pp, features company's meter for measurement of steam, air, or gas flow in 1 or 1¼ in. pipe lines, and designed for installation directly in the line being metered. Illustrated with photos of meter, sectional and dimensional drawings, bulletin discusses meter's advantages. Builders-Providence, Inc.

238 Putting the Ratio Totalizer to Work — Twelve suggested applications of company's ratio totalizer in automatic control circuits are described and illustrated by diagram in 8-pp Bulletin 5450. This new device is a pneumatically operated control mechanism for combining input control pressures and spring forces to produce a single output control pressure. Hagan Corp.

239 For Practical Men — That's the title of this 24-pp pocket-size booklet presenting insulation testing in simple language. Packed with maintenance hints, it explains electrical insulation, tells how it can be tested and what makes it go bad. It describes the Megger insulation tester and justifies its cost in terms of long run economy and avoiding shutdowns. James G. Biddle Co.

240 Air Locks — Bulletin S-31, 2 pp, describing company's air locks and trip master controls for holding regulating and control valves in position during failure of air supply, is illustrated with photos, diagrams and line drawings. The Swartwout Co.

241 Flow Tubes — Catalog 80, 4 pp, presents engineering data on a new primary element for measuring, regulating and controlling fluid flow. Tells how these flow tubes are designed and how they function. Foster Engineering Co.

242 Control Equipment — General Catalog 001, 30 pp, is devoted to measuring and control equipment for water and sewage works, power and processing industries. Catalog illustrates and describes in detail: venturi tubes and meters, controllers, gages, manometers, pilot equipment. Simplex Valve and Meter Co.

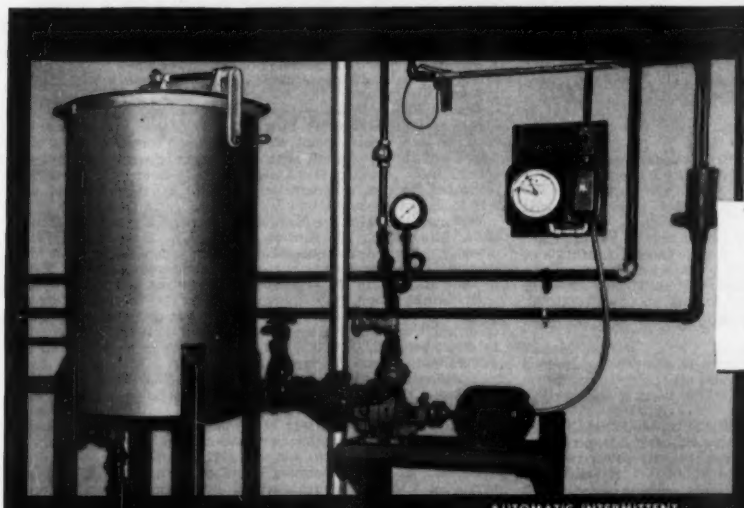
WATER CONDITIONING

244 Water Conditioning Information — Here are three informational bulletins of value to power engineers. No. 28X7446 describes a simple and accurate way to determine total hardness in water, illustrating procedure and explaining principle. No. 28X7559 gives an analysis of the hot process hot zeolite system, telling results to be expected and advantages. No. 28X7466 discusses current status of embrittlement in boilers, explaining causes and telling recent developments in control methods. List bulletins wanted. Allis-Chalmers Mfg. Co.

245 Modern pH and Chlorine Control — This 100-pp booklet gives technical details of company's color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on the meaning of pH control, electrometric and colorimetric methods of determining pH and also determining impurities in water; applications of water control in air conditioning; treating boiler feed water. W. A. Taylor & Co.

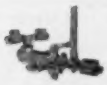
246 Water Softeners — Bulletin WC-102 is a 36-pp presentation of recent developments in hot-process water softeners. Explains boiler plant troubles caused by vari-

(*Continued on page 124*)

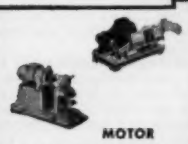


AUTOMATIC INTERMITTENT FEEDING

BY-PASS FEEDERS



MECHANICAL CHEMICAL PUMPS



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POWER PLANT Construction News

Gantt, Ala. — Alabama Electric Cooperative, Inc., Andalusia, Ala., plans two new steam-electric generating stations in vicinity of Gantt, each with capacity of 7500-kw. Entire project is estimated to cost close to $3,200,000. Financing is being arranged through Federal aid.

Mobile, Ala. — Alabama Power Co., Alabama Power Bldg., Birmingham, Ala., plans new steam-electric generating station at Mobile, to be known as Barry power plant, with turbine-generators, high-pressure boilers and auxiliary equipment for large capacity. Entire project is reported to cost about $30,000,000, with power substations, transmission lines and other operating facilities.

Phoenix, Ariz. — General Motors Corp., General Motors Bldg., Detroit, Mich., plans power house at new proving grounds at Phoenix, with shops, laboratories and other structures. Entire project is reported to cost over $5,000,000. Work is scheduled to begin soon.

Los Angeles, Calif. — B. F. Goodrich Co., 5400 East Olympic Blvd., automobile tires, tubes and other rubber goods, plans new power plant at local plant, to increase present power facilities about one-third. Cost reported about $1,000,000, of which over $600,000, will be expended for equipment. Main offices are at Akron, Ohio.

Los Angeles, Calif. — Richfield Oil Corp., 555 South Flower St., refined petroleum products, gasoline, etc., plans extensions in power plants and power facilities at oil refineries, in connection with an expansion and improvement program at refineries for large increased capacity. Program will be carried out over a period of about 24 months, and will represent a total investment of close to $40,000,000.

Pittsburg, Calif. — Continental Can Co., Fibre Drum Division, Van Wert, Ohio, fibre drums, barrels, etc., plans power house at proposed new branch plant at Pittsburg, where tract of about 45 acres of land has been selected. It will comprise several buildings for converting and other service, and is estimated to cost approximately $2,000,000. Proposed to begin work in near future.

Middletown, Conn. — Hartford Electric Light Co., 266 Pearl St., Hartford, Conn., and Connecticut Power Co., 31 Union St., New London, Conn., plan joint construction of new steam-electric generating plant with frontage on Connecticut River, near Middletown, where site has been selected. It will have an initial rating of about 65,000-kw, and is reported to cost approximately $10,000,000, with power substations, transmission lines and other operating facilities.

Rocky Hill, Conn. — Hartford Rayon Co., Rocky Hill, plans addition to boiler house at local rayon mill, with installation of additional equipment for increased capacity. Cost reported over $75,000. Work is scheduled to proceed at once.

Jacksonville, Fla. — Kieckhefer Container Co., Delair, near Camden, N. J., corrugated boxes and containers, plans boiler house at new branch converting plant at Jacksonville. It will be one-story, reported to cost about $200,000. Work will proceed soon. Marsh & Saxelbye, Hildebrandt Bldg., Jacksonville, are architects.

Soda Springs, Idaho — Monsanto Chemical Co., 1700 South Second St., St. Louis, Mo., technical and industrial chemicals, plans steam-generating plant at new branch works at Soda Springs, for production of elemental phosphorus. Installation will include electric furnaces and accessory equipment. Entire project is reported to cost over $3,000,000. Work will begin soon. H. K. Ferguson Co., 1783 East 11th St., Cleveland, Ohio, is engineer for power plant and other work.

Elston, Ind. — Eli Lilly Co., Inc., 740 South Alabama St., Indianapolis, Ind., drug and pharmaceutical products, will expend about $5,000,000 for power plant and facilities at new factory at Elston, near Lafayette, previously noted in these columns. Manufacturing and processing plant will be used for production of penicillin and streptomycin, and will represent a total investment of approximately $20,000,000, including amount noted, instead of a smaller sum formerly reported. Project is scheduled for completion in about 24 months.

Paris, Ky. — Detroit Harvester Co., 5450 West Jefferson Ave., Detroit, Mich., automobile parts, plans boiler plant at new branch factory at Paris, where site has been selected. It will be one-story, equipped for sizable output. Cost about $500,000. Work will proceed at once.

Hagerstown, Md. — Fairchild Engine & Airplane Corp., Aircraft Division, airplanes and parts, has approved plans for new steam-generating plant at local works, in connection with a general expansion and improvement program to cost in excess of $5,000,000, including buildings and equipment. Work will be carried out over a period of months.

Worcester, Mass. — Worcester County Electric Co., 11 Foster St., is arranging financing in amount of about $1,000,000, proceeds to be used for extensions and improvements in plant and system.

Grand Blanc, Mich. — General Motors Corp., Fisher Body Division, General Motors Bldg., Detroit, Mich., plans power house at new branch plant at Grand Blanc for production of equipment for Government Defense Program. Plant will comprise several units, totaling about 485,000 sq ft floor space, and is estimated to cost approximately $10,000,000. Construction is scheduled to begin soon.

Marquette, Mich. — Marquette Veneer Co., care of Haskelite Mfg. Corp., 701 Ann St., N.W., Grand Rapids, Mich., recently organized as a subsidiary interest, plans boiler plant at proposed new veneer and plywood mill at Marquette. Work will proceed at once. Entire project estimated to cost about $300,000.

St. Louis, Mich. — Michigan Chemical Co., St. Louis, plans power house at proposed new local plant for manufacture of liquid chlorine. It will comprise several multi-story units and is reported to cost about $3,000,000. Financing is being arranged through Federal aid. Roland P. Place is president.

Ypsilanti, Mich. — Ford Motor Co., 3000 Schaefer Rd., Dearborn, Mich., plans power plant at proposed new factory at Ypsilanti, for production of aircraft parts and accessories for Government. It will consist of a main one-story building and several smaller units, totaling in all about 400,000 sq ft floor space. Entire project reported to cost about $4,000,000.

Nyack, N. Y. — Rockland Light & Power Co., Nyack, is arranging financing through sale of bond issue to total about $6,000,000, proceeds to be used for expansion in power plant and other operating facilities.

Wilmington, N. C. — Tide Water Power Co., Wilmington, plans new steam-electric generating station near city, with initial capacity of 150,000 kw. Cost estimated about $23,000,000, including power substations, transmission lines and other operating facilities. Completion is scheduled early in 1954.

Oregon City, Ore. — Portland General Electric Co., 621 S.W. Alder St., Portland, Ore., plans expansion in Willamette Falls hydroelectric generating plant near Oregon City, with installation of new hydraulic turbines and electric generators to increase capacity from 5000 to 15,000-kw. Entire project is estimated to cost approximately $2,500,000. Work will be carried out soon.

Bedford, Pa. — Kennametal, Inc., Latrobe, Pa., cemented carbide tools, parts, etc., plans boiler house at proposed new branch plant at Bedford, for production of mining tools. Entire project is reported to cost over $175,000. Work will be placed under way soon.

Phoenixville, Pa. — Philadelphia Electric Co., 1000 Chestnut St., Philadelphia, Pa., has authorized extensions in new steam-electric generating plant at Phoenixville, now in course of construction, to be known as Cromby power plant, previously referred to in these columns. Designed for an initial capacity of 150,000-kw, station will now have a rating of 350,000-kw, with installation of 200,000-kw turbine-generator unit and accessories. It will cost in excess of $45,000,000, instead of $25,000,000, as originally planned. Entire plant is scheduled for completion in fall of 1954.

Charleston, S. C. — Gulf Oil Corp., Hurt Bldg., Atlanta, Ga., refined oils, gasoline, etc., plans boiler house at new oil compounding and canning plant on waterfront site on Shipyard River, Charleston, where site has been acquired. Entire project is reported to cost about $1,000,000. Main offices are in Gulf Bldg., Pittsburgh, Pa.

Lone Star, Tex. — Lone Star Steel Co., Lone Star, near Daingerfield, Tex., plans expansion in power plant at steel mill, with installation of additional generating and auxiliary equipment for considerable increased capacity. Cost reported close to $3,000,000. Proposed to begin work soon. Main offices are at West Mockingbird La. and Roper St., Dallas, Tex.

San Antonio, Tex. — Gaylord Container Corp., 111 North 4th St., St. Louis, Mo., corrugated paper boxes and containers, plans boiler plant at proposed new converting plant at San Antonio, where site has been selected. It will be one-story, equipped for sizable output. Cost reported close to $200,000. Work is scheduled to begin soon.

Salt Lake City, Utah — Utah Power & Light Co., Kearns Bldg., will expend about $18,400,000 during last half of present year for expansion in power plants, substations, transmission lines and other operating facilities, including like extensions for Western Colorado Power Co., Durango, Colo., a subsidiary interest.

Emporia, Va. — Martin Fabrics Corp., 48 West 38th St., New York, N. Y., silk and rayon narrow fabrics, plans boiler plan at new rayon weaving mill at Emporia, where site has been secured. Entire project will cost about $315,000. Approval has been granted by National Production Authority.

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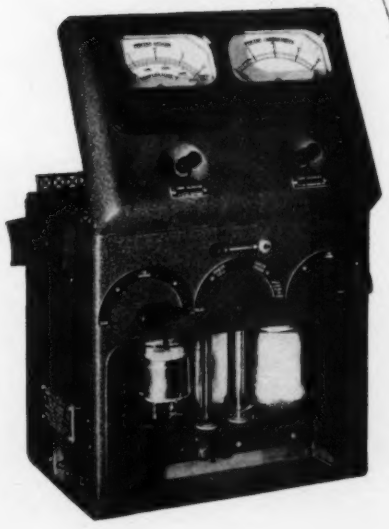
Now that the "heat's on" for record production, the calls are increasing for the services of the Cities Service Heat Prover. This scientific instrument gives an accurate, instantaneous and continuous picture of combustion conditions in all types of furnaces.

You'll readily be able to calculate any oxygen excess, waste combustible matter, and potential fuel savings. The results are like an accurate "diagram" of corrective measures needed to conserve heat units for consistently higher production at lower cost.

You'll see profit in applying the Cities Service Heat Prover . . . *not an instrument you buy, but a service we supply!* Call or write your local Cities Service office about arrangements. Or simply return the coupon today.



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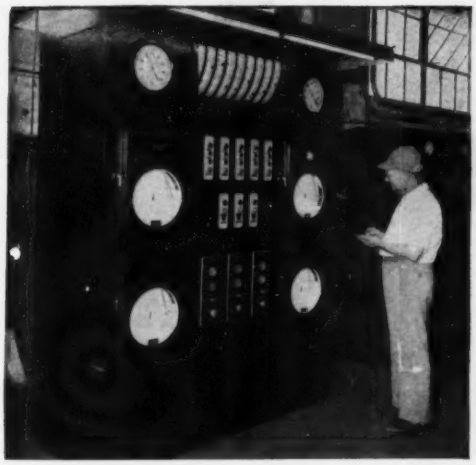
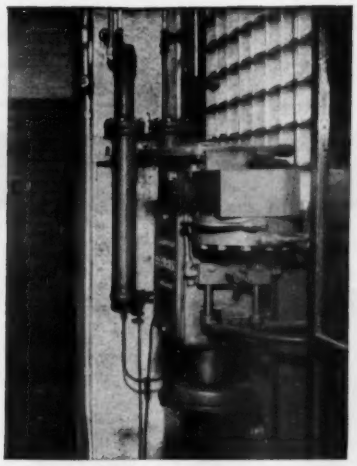
HAS THE ANSWER TO

View of boiler room showing stokers and Republic boiler instrument and control panel.





Left: **All essential boiler records and manual controls are centralized on the Republic boiler panel.**

●

Right: **Republic regulator controlling, in measured amounts, the air flow to the boiler.**

LOWER STEAM COSTS

A REPUBLIC automatic combustion control system that operates their boiler at test standards, 24 hours a day, is the answer.

Installed at the Hannibal municipal plant is a modern three drum, 90,000 lb. per hour, 400 psi boiler with forced and induced draft fans and fired by a traveling grate spreader type stoker.

The REPUBLIC control system enables them to take full advantage of those economies which have been "built in" their boiler and its auxiliaries. It automatically increases and decreases simultaneously the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency at all ratings.

The REPUBLIC combustion control system makes and co-ordinates these adjustments automatically, at the same time permits the operator to assume manual control from a centralized control point on the instrument panel whenever advisable.

REPUBLIC combustion control systems are designed and built for all sizes of boilers — all types of fuel firing — all load conditions and any arrangement of draft equipment. We will be glad to supply full information on REPUBLIC Control Systems — just write for Data Book No. S-21.

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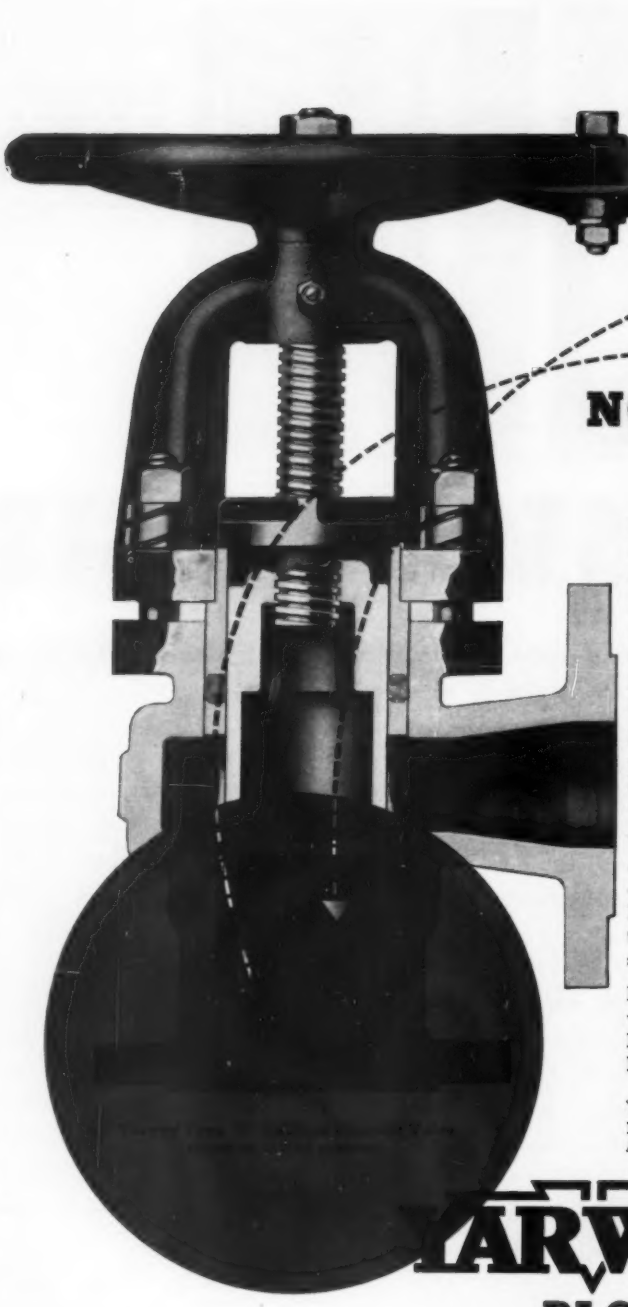

WHAT ?

NO SEAT ?

●That's right! In this Yarway Blow-Off Valve there is no seat to score, wear, clog and leak.

The unique balanced sliding plunger design eliminates a common cause of blow-down valve trouble—the seat. Many boiler shut-downs are saved . . . power interruptions avoided . . . production speeded.

Latest metallurgical improvements also make Yarway the ideal blow-off valve for difficult service where acid washing is used.

Yarway Seatless Blow-Off Valves are available singly or in tandem combinations for all pressures up to 1500 psi. For higher pressures up to 2500 psi, specify Yarway Stellite-seat valves.

For the latest information on blow-off valves, get Yarway's newest catalog—B-424 for pressures to 400 psi, B-433 for higher pressures.

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BLOW-OFF VALVES

STOP BLOW-DOWN TROUBLES—KEEP BOILERS ON THE

LETTERS TO THE EDITORS

GUSLER ON A-C POWER

WITH REFERENCE to the letter of Mr. P. H. Trout in the Letters section of the June issue of POWER ENGINEERING, I would like to explain how and why I arrived at certain figures.

2445 is the horsepower required when each machine is operated fully loaded. By way of illustration, suppose you are a furniture worker operating a five horsepower saw. Each time you cut a board 5 hp is required. During the time you are reaching for another board to cut, the motor is idling and drawing only the current necessary to magnetize the winding and overcome bearing friction.

To properly consider a standard factory the total installed horsepower must be considered. Since the plant is generally operated on a-c current at a power factor of 0.80 or better, it follows that the method used was a convenient means for converting to kilowatts and better represented the case under consideration.

Bassett, Va. DENARD L. GUSLER

PRESSURE DROP CALCULATIONS

REFERRING TO THE article by Chet A. Kershaw on page 78 of the January issue of POWER ENGINEERING, while I find Mr. Kershaw's Direct method of pressure drop calculation for viscous fluids very interesting, I still feel that the graphical method of Eiffel is the easiest and most direct method yet proposed. The following criticism of Mr. Kershaw's article was prepared by my associate, V. J. Groth.

Mr. Kershaw's simplified equation for viscous flow is

$$(1)\ P_v = GVS/b$$

and for turbulent flow is

$$(2)\ P_t = P_v C$$

where:

- G = Flow, Gallons/Minute
- V = Viscosity, Centistokes
- S = Specific Gravity
- P_v = Pressure Drop (Viscous)
- P_t = Pressure Drop (Turbulent)

and where C is a correction factor determined from Fig. 2 by means of the variable of Gh/V, and b and h are given in Table 1.

If it is desired to determine the flow rate, viscosity, or pipe size for turbulent flow when the pressure drop is known, *it is necessary to solve these equations by trial-and-error* since the correction factor C must be evaluated. If the flow is known to be viscous (C = 1), the equation (1) above can be solved for any missing variable.

However, for turbulent flow the "simplified" method can only be used to calculate the pressure drop when the flow rate, viscosity and diameter of pipe are known.

On the other hand, when using Eiffel's Logarithmic Vectors to solve piping flow problems, one can solve graphically for any variable *without the use of trial-and-error methods.* The solution of a typical piping problem consists of constructing successive vectors (as determined by the derived scales) representing the known variables. The length of the vector connecting this end point with the friction factor curve determines the value of the unknown sought. *Therefore, the Eiffel method appears to be simpler to use than the Kershaw method.*

Also, the vector scales can be so constructed to incorporate the units desired by the user. As an example the viscosity may be plotted as centipoises, centistokes, or Saybolt Seconds Universal; although, in the example solution, viscosity is shown only in centipoises.

WINSTON R. BURROWS

Mr. Kershaw's Reply

No claim has been made for the Simplified Direct Method that it will solve all flow problems with greater ease than afforded by other methods. Hence the author does not consider Mr. Burrow's letter as justifiable criticism. The author does claim that the Simplified Direct Method affords an accurate and faster method of solution than previous methods for the majority of flow problems facing most engineers, designers and operators. Its use requires only a slide rule and the tables and curves published in POWER ENGINEERING, Jan., 1951. The author does admit the mistake of not including the following discussion in his presentation of the Simplified Direct Method:

In all flow equations, the principal variables are pressure drop, pipe size, flow and viscosity. The vast majority of flow problems concern pressure drop as the unknown, simply because it is the most easily regulated and controlled of all the variables. Pressure drop represents a facilities *limit* which must be considered. It is commonly regulated from a recording flow controller or similar device. Flow metering by equation, however, represents *only* a possibility which must be verified for purposes of production control by an accurate flowmeter installation. The flowmeter actually measures pressure drop in a very short section of line wherein all physical conditions are controlled. The cost of duplicating such close control throughout the entire line would be prohibitive.

Pipe sizing by flow equation represents both a possibility and a limit to be met, but practical experience of the engineer or the operator usually closely indicates beforehand the size of pipe required. Viscosity determination by flow equation is unreliable, except where a definitely known Newtonian fluid is used or where a conduit has been set up under controlled physical conditions and tested for viscosity measurement. Viscosity determination by flow equation is principally useful only for estimating necessary safe Btu requirements.

The principal object in development of the Simplified Direct Method, as presented in POWER ENGINEERING, was fast and accurate solution of the more common flow problems. It could have been developed for any of the principal variables mentioned above, but each rearrangement would have required a separate set of non-dimensional factors and curves similar in use to those employed in the present arrangement. It is questionable whether any but the purist or the very occasional user would bother with these additional forms, for foregoing reasons.

Most problems concern Schedule 40 (standard) pipe. The following extended equations may be used with any size conduit, without the use of charts, curves, tables, nomographs or vectors, except in arrangements containing the term, (Y):

$$P_t = CP_v$$

$$P_v = \frac{(SY)GU}{16.68d^4} = \frac{GvS}{3.67d^4} = \frac{Gz}{3.67d^4}$$

$$C = \frac{N}{4562.6} + \frac{(N)^{0.676}}{60.35}$$

$$N = \frac{14{,}363\ G}{YUd} = \frac{3160\ G}{vd} = \frac{3160\ GS}{zd}$$

where:

- P_v = Viscous psig drop per 1000 ft conduit
- P_t = Turbulent psig drop per 1000 ft conduit
- C = Friction factor (non-dimensional)
- N = Friction factor determinant
- S = Specific Gravity, referred to water @ 60 F
- G = Gallons per minute flow
- Y = SSU viscosity correction factor (non-dimensional)
- U = Seconds, Saybolt Universal viscosity
- v = Centistokes, kinematic viscosity
- z = Centipoises, absolute viscosity
- d = Actual inside diameter of conduit

It would appear from the criticism of Messers Burrows and Groth that vector solution of a flow problem

(*Continued on page 118*)

Hoosiers and Wolverines Get More AG & E Power, at 9300 Btu per Kwh, from

TANNERS CREEK—

First 150,000-kw unit
2000 psi . . . 1050 F
Reheat to 1000 F

Fig. 1. Tanners Creek as it appears now, containing initial 150,000-kw turbine generating unit, supplied with 2000-psi, 1050-F steam, with reheat to 1000 F, by a single 930,000-lb-per-hr, pulverized-coal-fired boiler. On roof is part of 132-kv transmission line structure. Second similar turbine generator and boiler will be in service in 1952

TANNERS CREEK steam-electric power plant in southeastern Indiana was recently dedicated by Indiana & Michigan Electric Co. "to the service and welfare of the people of Indiana and of Michigan". Representing what is claimed to be one of the most economical power stations ever constructed in the world, it is the tenth major generating plant erected on the American Gas and Electric System, and the third built since the war. Construction of its initial 150,000-kw unit, operating on 2000-psi, 1050-F, steam, with reheat to 1000-F, was started September 1, 1948 and the unit was placed in commercial service March 21, 1951. The second unit, having the same rating, is scheduled for service in July 1952. Total cost of these two authorized units is estimated at $33,500,000.

They will produce power with 9300 Btu per kwh. This economy is made possible by incorporation of the most modern practices.

Located 90 miles southeast of Muncie, the 200-acre site on the Ohio River can accommodate considerable expansion of capacity, when needed, because of adequate condensing water and economical coal transportation along the Ohio River from West Virginia and Ohio coal fields.

The plant is now tied to the 132-kv AGE transmission network near Anderson, Indiana, by a double-circuit line.

Turbine and Boiler

With two units in service and operating at full load, this plant will burn around 800,000 tons of coal per year and produce 1,860,000 lb of steam per hour with just two boilers. The 275,000-ton outdoor coal-storage yard will assure at least 3-months' coal supply in times of emergency.

In the 150,000-kw cross-compound turbine generator, the high-pressure unit generates 40,000 kw and the low-pressure unit 110,000 kw. The high-pressure unit shaft revolves at 3600 rpm and the low-pressure unit shaft at 1800 rpm. There are 7 extraction points. Generator voltage is 13,800 v. Exciters are directly connected through flexible couplings. The high-pressure exciter is rated at 145 kw and the low-pressure exciter at 350 kw.

The condenser has 65,000 sq ft of surface. There are 2 circulating water pumps, each with a capacity of 50,000 gpm, pumping the water from the Ohio River.

The boiler's rated output is 930,000 lb per hr. Boiler and furnace heating surface is 31,550 sq ft. Superheater surface is 64,570 sq ft; and reheater is 31,293 sq ft. Economizer is 16,387 sq ft and each of 2 air preheaters has a heating surface of 140,700 sq ft. Firing is vertical, with 10 multi-tip burners.

Two forced-draft fans are installed, each having a capacity of 167,500 cfm; and 2 induced-draft fans, each having a capacity of 239,000 cfm. Three boiler feed pumps are rated at 600,000 lb per hr each.

The boiler is designed for pressurized firing and operated under pressure for normal service. It swings over to minus pressure only when it is necessary to do certain maintenance work.

The centralized control room gives full indication and control of all related plant operating conditions. Television facilities show water level in the boilers and condition of the flames at each pulverized-coal burner.

Tanners Creek Plant was designed by American Gas and Electric Service Corp., which also supervised its construction.

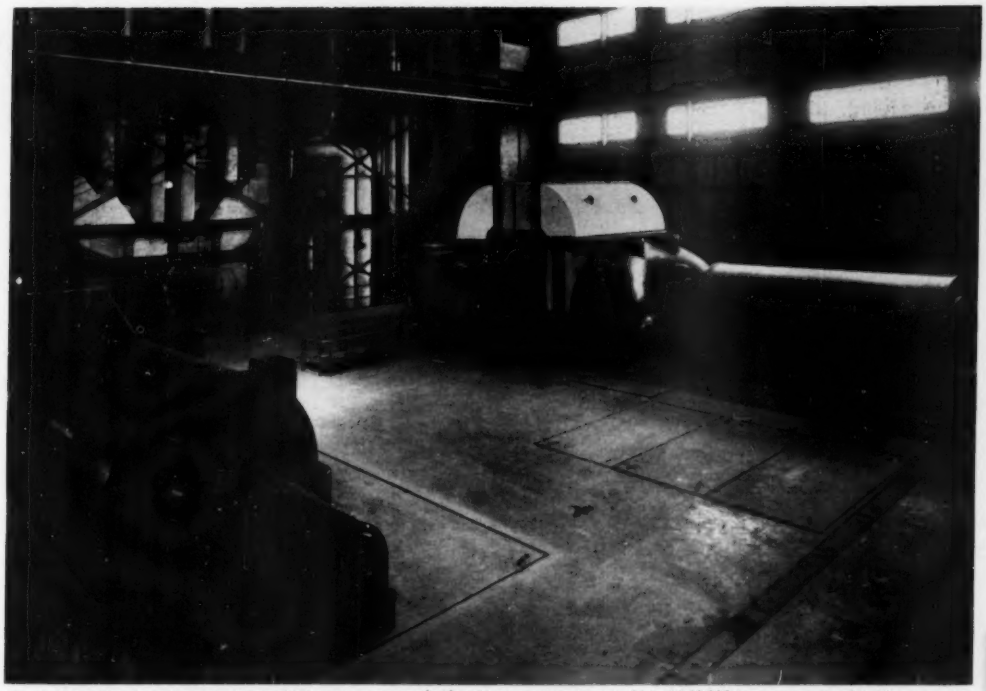
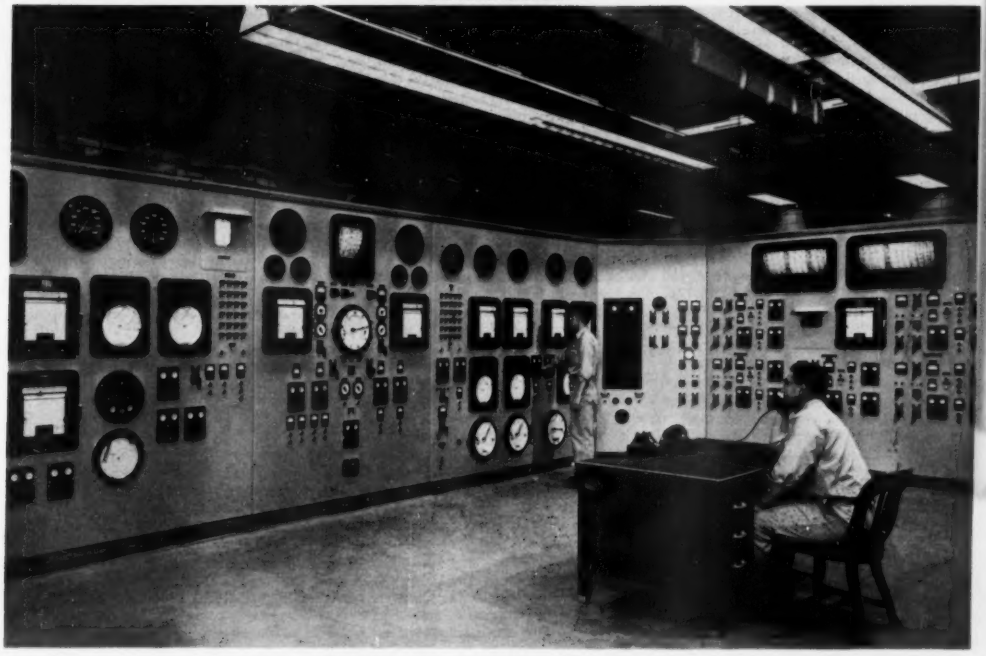


Fig. 2. Above. View in turbine room showing high-pressure element (left) and low-pressure element of initial 150,000-kw cross-compound turbine generator. Generation is at 13,800 v, stepped up to 138,000 v for transmission

Fig. 3. Below. Part of centralized control board in Tanners Creek station where entire operation of plant is controlled. One feature is use of television for remote observation. Engineer at desk is looking at shaded television screen on vertical panel. Other screens are over his head. These screens show boiler water level and burner conditions



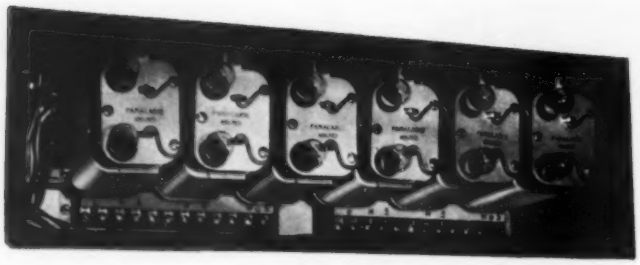


Fig. 1. A modern annunciator

This annunciator functions as follows:
1. Alarm contact closing causes horn to sound and associated lamp to flash.
2. Operator presses "Horn Reset" button, which silences horn but lamp continues to flash.
3. Operator presses "Lamp Reset" button which causes lamp to burn continually if the alarm contact is still closed, or to be extinguished if the alarm contact has opened. Thus the latest alarm shows up as a flashing light while the acknowledged alarm has a continuously lit lamp.

"Now Hear This!"—

Modern Power Plant Communication

By W. B. **JARZEMBSKI**, Project Engineer, Panellit, Inc., Chicago, Illinois

Engineering a power plant communication system requires different techniques from those used in theaters, ball parks and other types. . . . This article tells you what they are and why. . . . Here are practical data on how to use audible and visual signal systems, telephone systems, sound systems, carrier and radio systems, for best results in power plants. . . . How to place loud-speakers properly

IN RECENT years, the adoption of centralized control in modern power plants has resulted in personnel reductions as high as 75 per cent. A study must be made in all cases to determine the cost of centralized control as compared with its value. Included should be the determination of the adequacy of the existing communications system and the improvements necessary to this system to give the service required for the particular scheme of centralization.

The basic forms of communications equipment may be classified in major groups, as follows:

A. Audible and visible signal systems or both
B. Bell Telephone Systems
C. Privately-owned telephone systems
D. Sound systems consisting of microphones, amplifiers and loudspeakers
E. Carrier telephone systems
F. High frequency radio

These were discussed by the author in a paper before the 13th Annual Midwest Power Conference at Chicago, from which the following is abstracted.

Audible Signal Systems

The audible signal system using a bell, buzzer or gong, is the oldest system in use and in most cases is being replaced by one of the other systems. There are many applications, however, where the audible signal serves a useful purpose and has no substitute. As part of an annunciator, the signal attracts the operator's attention and causes him to take action before being silenced. In cases where a sound system is not justified, an audible signal may call a man to work, inform him of his lunch period and tell him that 5 o'clock has arrived. In this group fall the various types of annunciators, a typical example of which is shown in Fig. 1. This is but one of the many types of annunciators available today.

Telephone Systems

In many instances the communication problem may be solved by the use of Bell System facilities at a lower cost than the annual charges on a privately-owned system. In some cases where intra-plant communications are held to a minimum, the use of separate Bell System phones for each location is justified.

The manual type of PBX is in common use where it is possible to have a receptionist or to keep a man at one spot to answer the telephone. In most plants this is not possible, so the dial type of PBX may be used. This equipment is usually arranged so that intra-plant calls are made by dialing two or three digit numbers and calls outside the plant are made by prefixing the telephone number with an extra digit which transfers the call to an outgoing trunk. Thus, in a locality which does not have automatic switching telephone service, the plant telephone may use automatic switching.

Today there are many installations of privately-owned telephone systems. Various types of equipment can be purchased from the Bell system, and complete telephone systems can be purchased from other major manufacturers. The simplest form of privately-owned telephone system consists of two or more "Sound-Powered" telephone handsets and the necessary wire, plugs and receptacles. This form of communication finds wide usage in maintenance work. In many plants, one circuit is carried throughout the building with receptacles at convenient locations, so that communication may be set up from any part of the plant to any other part.

The next step is the privately-owned PBX. One major reason for private ownership is the difficulty of obtaining special circuits on a leased switchboard. Many private switchboards are connected with alarm systems, carrier telephone, sound systems and often phonograph amplifiers. It is possible, in many localities, to tie a privately-owned telephone system with the Bell System, but in some instances difficulty has been encountered, due to the rules of the local telephone company or the incompatibility of the two systems.

Sound Systems

Power plant acceptance of sound systems has been slow. This is due in part to the fact that the special problems involved have not always been recognized. Installing a sound system in a power plant and in a movie theatre are two entirely different problems. For this reason it is well to select personnel with sufficient education and training for power plant sound system design and maintenance.

In power plant sound systems, the basic problem is to provide sound of sufficient intensity and clarity so as to be intelligible in specific areas, such as the Boiler Control Board, the Generator Control Board, the Firing Aisles or the Turbine Controls. The latter locations are extremely noisy, while the former are relatively quiet.

For power plant sound systems, current practice is to treat the sound system as a power system. The input to the amplifiers is set for best performance; the output of the power amplifiers is set to provide a certain voltage for the transmission system. Each speaker is then tied to the transmission system by means of a step-down transformer, which is adjusted not for impedance match, but for proper sound intensity at the particular location. Thus, the sound level is adjusted at the individual speakers rather than at the amplifier.

Noisy locations also accentuate the problem of speaker selection. It has been quite common in the past for many people to select as large a speaker as possible to override the interference. Practice will show, however, that it may be better to use two or more small speakers instead of a single large one.

The proper selection of a microphone is not difficult, but is important. A close-talking dynamic microphone is best suited for noisy locations; this mike has the property of being extremely insensitive to noises more than 6 in. from the diaphragm. A carbon microphone may be used but the noise pickup, electrically and physically, is greater than desired. The carbon mike has the advantage of being suitable for use with a normal telephone system or sound system.

The selection of the proper speakers is much more difficult. Once the selection of a microphone is made, the same type is generally used throughout the system, while as many as six or eight different types of speakers may be used in the same system. Reference to Fig. 3 will show the basic problem involved in speaker selection. The ordinate represents a projection on the floor of two loud-speakers and a noise source, while the vertical distance represents the sound intensity, I, in arbitrary units. Curve A represents a noise source; curves B and C represent the sound intensity from two identical loud-speakers.

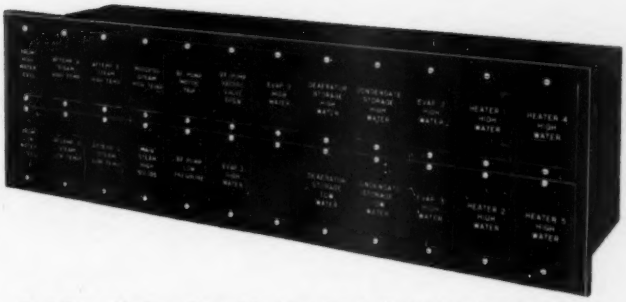


Fig. 2. This combination audible and visual annunciator is often seen in modern power stations

It may be noted that although the loud-speakers at B and C produce sound of equal intensity, C is louder than the noise source only from its location to the point X, while the speaker at B is louder than the noise by an amount almost constant and at all points from its location out. It is necessary, for intelligibility, that the sound exceed the noise by a certain amount, dependent upon the noise intensity.

It can readily be seen that, for locations near C, the sound is too loud for comfort and the total distance of intelligible sound is much less than for the speaker located near the noise source. Since sound intensity diminishes as the square of the distance, the speaker at B need not be far from the noise source to sufficiently override the interference.

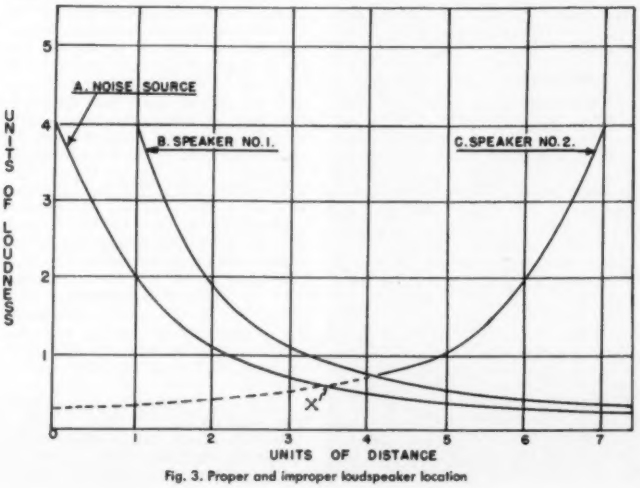


Fig. 3. Proper and improper loudspeaker location

Sound systems are often integrated into the overall communications system with very satisfactory results. The microphone may be mounted in a regular handset and the speakers used only for paging or general announcements by pressing a button on the handle. When the button is released, the handset functions as a local station of the telephone system.

Proper preventive maintenance has long been recognized as essential for circuit breakers, m-g sets, batteries and other central station equipment. The same holds true for a communications system. If a company does not feel that the expense of a full-time man is justified for communications maintenance, it is generally desirable to obtain a service contract with a local specialist.

Carrier Telephone

The use of carrier current communications is an accepted fact with most public utilities and this equipment is very dependable. The most simple system is the "Push-To-Talk", in which both terminals occupy the same channel and only one terminal can be used at a time. This system may be refined by use of electronic switching, so that the act of talking into the microphone switches on the carrier transmitter. This, however, is expensive, and justified only where channel space is limited and it is not desirable to use single sideband carrier. Where channel space is not crowded, the duplex system is very common. By having each terminal transmit on one frequency and receive on another, it is possible for both terminals to transmit simultaneously.

The communications systems described in the foregoing may be used singly or as parts of a composite system, the complexity of which depends on the size of the power plant and the results desired. The most common combination is a private telephone system and carrier current communications. Although it is possible to purchase these systems complete, it is still desirable to make a study of the individual plant requirements. The proper coordinations of the various components of the final system is necessary to achieve complete satisfaction.

Fig. 1. Aerial view of the big new Halliburton mill at Corpus Christi. The company generates its own power regardless of the proximity to a steam power plant. (Shown at upper right)

Dual-Fuel Engines Power Texas Cement Plant

Four engines, rated at 7200 horsepower, supply power to the Halliburton Portland Cement Company. The system is more economical than it would be to purchase power from a modern steam utility power plant a stone's throw away. Heavy starting loads and power requirements are satisfied by the company-owned power plant. During the first year of service, the plant has not experienced a single shut-down due to engine failure. A modern complement of auxiliary equipment and controls supplements the power plant's generating units

FOUR dual-fuel engines are meeting a difficult dual challenge in the big new plant of the Halliburton Portland Cement Company at Corpus Christi, Texas. First, there is the economic challenge: a big modern utility steam plant is located just a few yards away and engine operating costs must compare favorably with the cost of purchased power. Second, there is the operating challenge: the big ball grinding mills and other processing equipment are always a taxing load and sometimes a staggering load for the power plant.

Rounding out their first year of service, the engines have met both these challenges with unqualified success. First, Vice-President Ellroy King reports that it has been profitable to operate dual-fuel engines. Second, the plant has not experienced a single shut-down due to engine failure.

All four engines are two-cycle, Model 33FD16 Fairbanks-Morse dual-fuels of 16-in. bore and 20-in. stroke, developing rated horse-power at 300 r p m. Two of the prime movers are 10-cylinder units rated at 2000 hp and two are 8-cylinder engines rated at 1600 hp. The larger engines drive 1400-kw, 4160-v Fairbanks-Morse alternators; the smaller engines turn 1125-kw F-M alternators.

5600 hp for 1,500,000 bbl

The multi-million-dollar Halliburton mill has a capacity of 1,500,000 barrels of portland cement a year and incorporates many unique design features. Though not the first to make cement from oyster shells, this is the first cement mill to grind oyster shell in closed circuit with rake and bowl-type classifiers. All raw materials — shell, clay, and bauxite and iron ore — are ground separately and stored as slurry in individual tanks to permit maximum flexibility in blending the product. Another unusual feature is the provision of duplicate equipment which not only insures continuity of production but makes it possible to operate two complete circuits independently. Thus, the plant can run at half capacity or produce two different cements simultaneously.

Cement manufacture requires heavy, power-consuming equipment. The two primary grinders are 8 by 16-ft. Allis-Chalmers ball mills driven by 450-hp Electric Machinery synchronous motors. A secondary mill for shell grinding takes another 450-hp motor. G.E. 100-hp motors turn the two 377-ft. kilns and each kiln has two induced draft fans driven by 100-hp motors. Clinker is ground into cement in two 7 by 40-ft Allis-Chalmers 3-compartment ball mills driven by 700-hp Electric Machinery synchronous motors. Cement is pumped to storage by two pumps driven by 150-hp EM motors and the pumps are served by two rotary compressors driven by 200-hp motors. This obviously is but a fragmentary list of equipment. In all, it takes 5600 hp to operate the plant at capacity, a load which can be carried by three engines with one 1600-hp unit in reserve.

It is the practice in this plant to run engines at full load. Units in operation must run at an overload before the operator starts up another engine. Even the 5600 hp require-

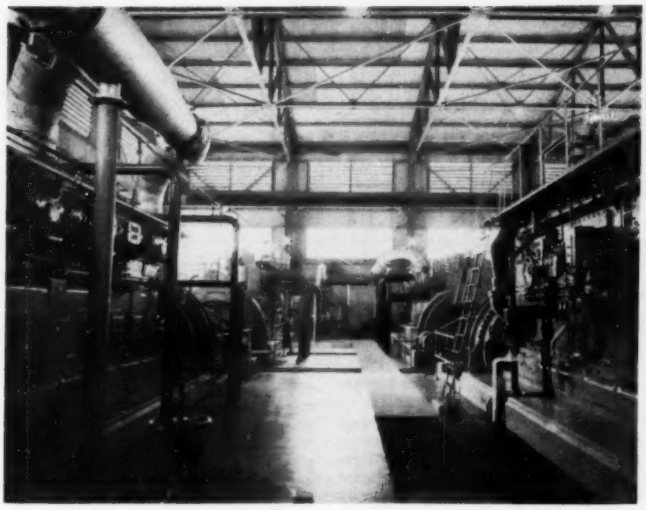


Fig. 2. The four Fairbanks-Morse engines are producing power at the rate of 25 million kwh a year. There has never been an engine failure. The dual-fuel engines drive Fairbanks-Morse alternators with V-belt driven exciters. The two engines shown in the foreground are 2000 hp each; the 1600 hp engines are shown in the background

ment, however, is not the full story on power demand. Pieces of heavy machinery stop and start and the starts take lots of power. For example, the mills that grind clinker into cement each hold about 6500 lb of 3½-in. balls, 14,600 lb of 3-in. balls and 14,000 lb of 2-in. balls in the first compartment; 44,500 lb of 1¼-in. balls in the second compartment; and 61,800 lb of ⅞-in. Concavex media in the third compartment. There are no clutches and the 700-hp electric motor is started across the line, pulling an estimated 500 percent overload. Works Manager A. J. Anderson reports that the big mill is usually started when the engines in operation are already fully loaded, yet they take the sudden surge of demand in stride.

This was one of the factors which influenced Halliburton to put in its own power plant, since the power company took a dim view of starting the big motors across the line. Economy was another big factor. Demand charges for purchased power were bound to be high. Initially, it would be necessary to construct a big substation. Finally, natural gas is cheap in Texas and dual-fuel engines promised to generate power at competitive costs.

The four-engine plant first went into service in December 1949 and reached full production in 1950, producing at the rate of 25,000,000 kwh a year. The first six months for which complete operating figures are available are reported in the table. In that six-month period from July through December 1950, the plant generated 12,775,700 kwh while consuming 139,977 mcf of natural gas and 94,227 gal of fuel oil. This represents an average consumption of 10.96 cu ft of gas per kwh. Pilot fuel supplied 7 percent of the Btu's. The four units ran a combined total of 13,816 hours out of a possible 17,520. During this time, lubricating oil consumption totaled 5422 gal, an average of 4601 hp-hr per gal.

Engines and Auxiliary Equipment

The engines can operate either as full diesels or on natural gas with oil as pilot fuel, and can be switched instantly from one fuel to the other. There have been several occasions when the gas supply failed and the engines automatically switched to fuel oil while running at full load. Gas reaches the plant at 50 to 60 lb pressure, is regulated to 56 lb by an orifice fitting, is metered, and then reduced to 17 lb in individual regulators for each engine. Fuel oil flows by gravity from storage to four 600-gal day tanks. Picked up by engine-driven supply pumps, the fuel is pumped through duplex filters to the special small-capacity injection pumps that handle the pilot oil.

A straight mineral oil is used to lubricate the engines and cool the pistons. Oil is circulated under pressure by built-in engine-driven pumps to the bearings and pistons and through a shell-and-tube oil cooler. Part of the oil is drawn from the crankcase continuously and put through a Fuller's earth purifier for each engine. Upper cylinders are supplied with lube by force-feed mechanical lubricators which are filled automatically from the crankcase oil supply. Each engine has a motor-driven auxiliary lube pump for use in starting and shutting down.

Each engine has a separate closed cooling water system with a motor-driven centrifugal pump circulating soft water through the engine jackets and a shell-and-tube heat enchanger. Jacket makeup water is treated in a zeolite softener. Nueces Bay, which adjoins the plant, provides a supply of salt water for the raw circuit. The salt water is taken from the bay by three vertical turbine pumps, put

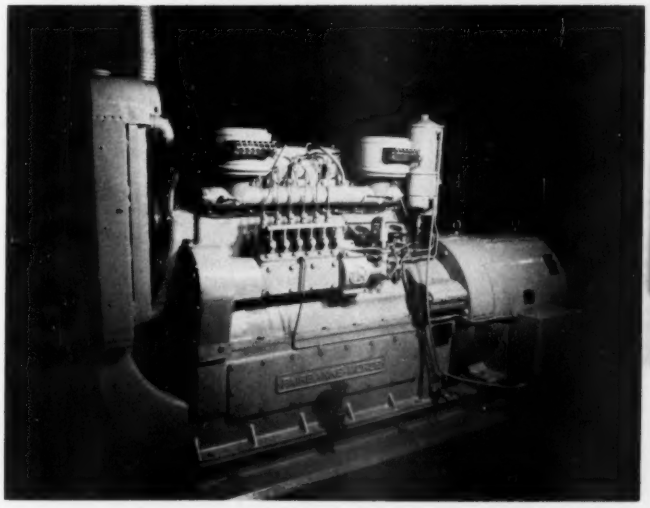


Fig. 3. This 30 kw Fairbanks-Morse Diesel generator set kept the thickener going in an emergency preventing possible prolonged shut-down of the plant. It also provides power for lighting and engine auxiliaries

Table of operating data taken over a six month period

1950	Kwh Generated	Gas, MCF	Cu-ft Gas Per Kwh	Fuel Oil Gal	Hours No. 1 2000 hp	Hours No. 2 1600 hp	Hours No. 3 2000 hp	Hours No. 4 1600 hp	Lube Oil, Gal	Hp-hr Per Gal Lube
July	2,305,100	25,505	11.06	15,489	682	597	606	530	984	4450
Aug.	1,931,300	21,814	11.29	13,235	568	503	503	558	831	4613
Sept.	2,116,800	22,507	10.63	15,698	613	539	642	525	891	4709
Oct.	2,174,900	23,769	10.92	15,300	607	576	577	587	894	4741
Nov.	1,913,800	21,225	11.09	15,909	538	578	449	584	931	4117
Dec.	2,333,800	25,157	10.73	18,596	666	517	656	615	891	5000
Total	12,775,700	139,977	10.96	94,227	3674	3310	3433	3399	5422	4601

through the exchangers and discharged to the bay. Jacket temperature is regulated by automatic thermostatic controls which bypass soft water around the exchangers.

The 1600-hp units have built-in scavenging pumps. The 200-hp engines are supplied with scavenging air by motor-driven rotary positive blowers. Air for each engine is drawn from outside the building through 16-element impingement-type filters in metal air houses. Exhaust gases vent through vertical silencers. Starting air is provided by a pair of vertical motor-driven compressors which keep four bottles at 250 psi.

The power plant's main switchboard is of the all-enclosed, deadfront, unit type with electrically-operated switchgear and particularly complete instrumentation. There is also a guage panel beside each engine with an exhaust pyrometer, day tank level meter, gauges and alarms on lube and water pressure, and switches for engine auxiliaries.

One piece of equipment that already has earned many times its price is a 6-cylinder Model 48AG4¼ Fairbanks-Morse Diesel which turns an Electric Machinery synchronous generator at 1200 rpm to develop 30 kw. The most crucial piece of production machinery in the mill is the thickener on which the entire plant depends. The thickener must run constantly and, if power failure caused it to stop, the mill might be shut down for a prolonged period.

Diesel-Generator Set Performs Varied Tasks

To insure an unfailing power supply, plant designers provided three alternate sources: a special line to the nearby utility plant, the mill's own four-engine power plant, and finally the little Diesel-generator set. If one source fails, an automatic device switches the thickener motor to the next source, and then, if necessary, to the third. On one occasion, lightning knocked out the transformers of both the utility and the big dual-fuels and it was the 30-kw generator that kept the thickener going.

This standby service is most important, but the little Diesel has other functions. It provides enough power to light the entire mill and operate starting air compressors and other engine auxiliaries when all the big engines are shut down.

There is evidence throughout the mill of Halliburton's determination to manufacture a fine product with maximum efficiency. In the power plant this is evidenced by the heavy-duty prime movers and their full complement of protective accessory equipment. It is an extremely attractive plant and its appearance reflects the pride of management and operating personnel. The engines are painted gray-green, foundations gray, and floors Spanish tile red. All piping and equipment are painted in accordance with a color code which not only enhances the appearance of the plant but facilitates quick identification and correction of trouble.

A preventive maintenance program is designed to keep the engines in peak condition. In the first year, no repairs were necessary.

Management of Halliburton Portland Cement Co. is energetic, progressive and thoroughly experienced. Erle P. Halliburton is president; Ellroy King, vice-president, secretary and treasurer; Erle P. Halliburton, Jr., vice-president; A. J. Anderson, works manager; Keith Sandefer, chief engineer; H. R. Gingerich, chief chemist; and Marshall Clements, sales manager. Power plant superintendent is Herbert Bolt.

Power Plant Equipment Listing, Halliburton Portland Cement Co., Corpus Christi, Texas

Engines: Two 2000-hp and two 1600-hp Model 33FD16, 2-cycle, 300 rpm, dual-fuel engines. Fairbanks Morse & Co.

Generators: Two 1400-kw and 1125-kw, 3-phase, 60-cycle, .8 power factor, 4160 volt alternators. Fairbanks Morse & Co.

Blowers: Roots-Connersville

Air filters: Air-Maze

Exhaust silencers: Maxim

Lube oil: Gulf Security E

Lube purifiers: Honan-Crane

Oil coolers: Ross

Auxiliary lube pumps: Roper

Fuel filters: Nugent

Gas regulators: Fisher

Cooling water pumps: Fairbanks Morse & Co.

Heat exchangers: Ross

Water softener: Fairbanks Morse & Co.

Exhaust pyrometers: Alnor

Levelmeters: Levelometer Corp.

Fuel oil: Humble Oil Co.

Natural gas: Houston Natural Gas Co.

Switchboard: I.T.E.

Switchboard instruments: General Electric Co.

Air compressors: Gardner-Denver

Standby Diesel: Six-cylinder, 1200 rpm, Model 48AG4¼, Diesel generator set. Fairbanks Morse & Co.

SEVEN MILLION VOLT X-RAY AIDS INDUSTRY

RADIOGRAPHY X-RAYS produced at several million volts are finding increasing application in industry, J. C. Trump, Massachusetts Institute of Technology, told the AIEE at their Summer General Meeting.

"Heavy metal sections can be X-rayed with sensitivity and definition fully equal to that obtained on thin sections at lower voltages," Mr. Trump said.

Electrostatic generators developed during the war at Massachusetts Institute of Technology especially for military radiography produced 2,000,000-v radiation from a spot on a water-cooled gold target less than ten mils in diameter. With an electron current of 300 microamperes, steel sections eight inches thick could be radiographed with an exposure time of three minutes, four in. steel plate in six seconds. Defects of less than 1.5 per cent of the total plate thickness could be readily discerned on the film, complex forgings were found to be readable over a wider thickness range on a single film, and the necessity of packing complex shapes in shot or sand to reduce scatter was eliminated.

An extreme example of the dependence of exposure time on the X-ray voltage was cited in a report of this MIT group. The measured exposure time on a 14-inch-thick steel submarine forging at two million volts and 400 microamperes was four hours. Calculations based on experimental data indicated that at one million volts and with otherwise similar conditions, the exposure time would have been about 12 weeks, while at 0.5 million volts the time would have been about 500 years. With 200 milligrams of radium under these conditions, it was computed that an exposure of about five years would be required. On the other hand a careful calculation for four million-volt X-rays showed that the required exposure would be only about 1 min.

Enlarging further in his paper, "Electrostatic Sources of Ionizing Energy," Mr. Trump stated: "The growing need in science, medicine, and technology for intense sources of high-energy particles and other forms of ionizing energy is being met to an increasing extent by devices which depend upon electrostatic acceleration."

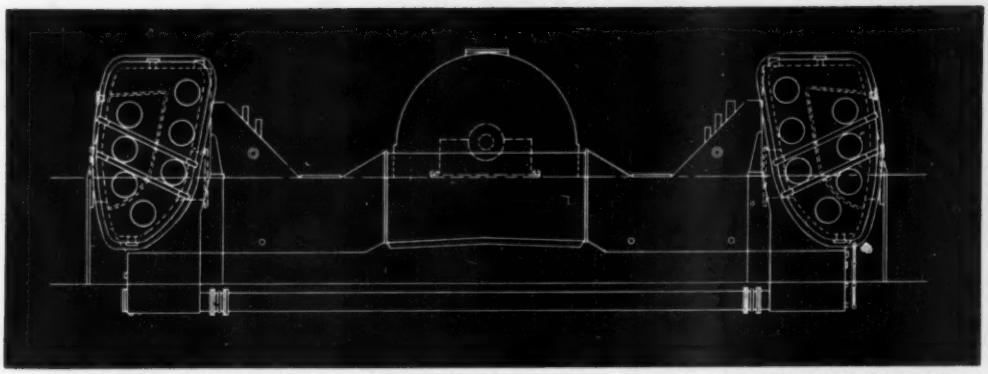


Fig. 1. General arrangement of outdoor side-exhaust turbine and 2-piece inverted condenser at Handley Station. Pipes leading into top of exhaust pieces bring in make-up and drains for deaeration in condenser hotwells. Condensers supported on socket mounted columns, inclined slightly toward turbine when cold. When solid-wall exhaust pieces expand in operation, columns swing back slightly, allowing condenser to move horizontally and obviate excessive bending moment at turbine exhaust

Side-Exhaust Turbine Plus 2-piece Condenser Keep Foundation Low

UNUSUAL and interesting condenser installation at the new Handley Station of the Texas Electric Service Co. near Fort Worth, Texas, is shown here. This is an outdoor station, one of a number designed by Ebasco Services, Inc. and erected in the Southwest.

The two 32,500-sq-ft condensers, serving a GE 65,000-kw, side-exhaust turbine generator, are actually the two halves of a standard Foster Wheeler cross-flow, divided-water-box, center steam-lane condenser, each half being installed "upside down" and placed on opposite sides of the turbine as in Fig. 1, as shown recently in *Heat Engineering*.

The 65,000-kw unit was installed with the turbine operating level only 8 ft above grade, thus reducing height of crane structure to a minimum. The increased "floor" area is relatively unimportant in an outdoor installation. Crane columns are erected between turbine and condensers to reduce length of main crane boom.

Construction Details

Each condenser, Fig. 2, has total surface of 32,500 sq ft, made up of 7/8 in. O.D. No. 18 BWG arsentical copper tubes, effective length 28 ft, arranged for two-pass circulating water flow. Condensers are designed to maintain exhaust pressure of 3.5 in. Hg abs with heat load of 595,000 Btu per hr when supplied with 60,000 gpm of circulating water at 95 F.

No deaerating heater is used; the condenser provides all deaeration. It is designed to supply water at the hotwell pumps having an oxygen content of not more than 0.01 cc per liter at normal operating conditions.

In addition, makeup, feedwater heater drips, boiler feed pump recirculation, air ejector inter- and after-condenser drains, and other miscellaneous drains and drips must be returned in a deaerated condition to the feedwater cycle. These are brought in through vertical pipe extensions in the top of each exhaust piece, Fig. 1.

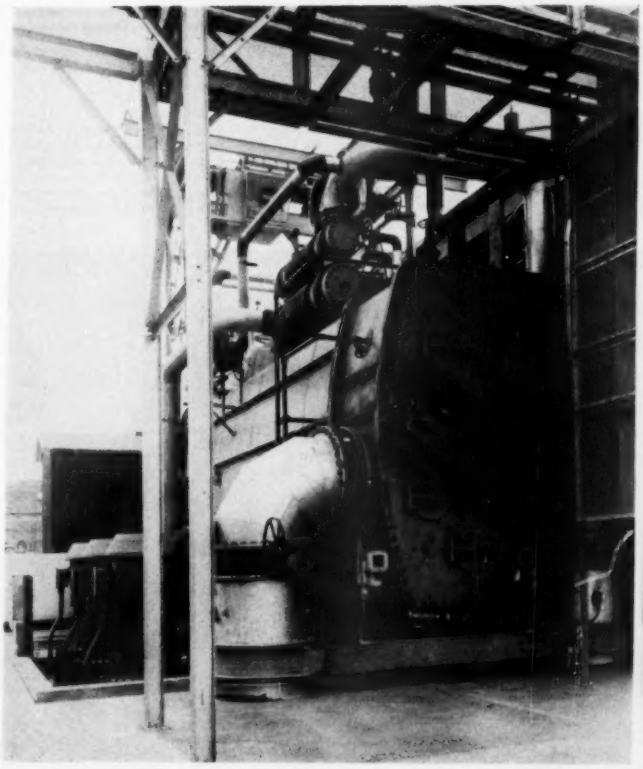
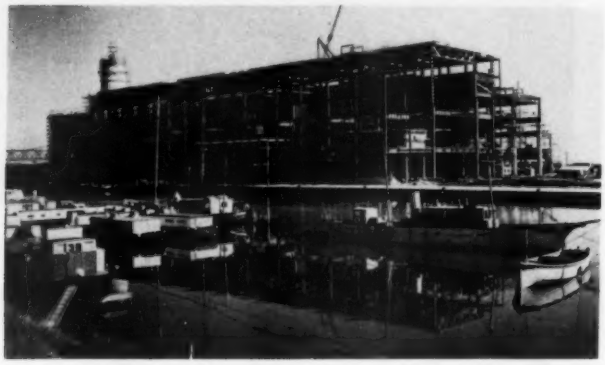


Fig. 2. View of one-half of 2-piece condenser of Fig. 1. At left, three 6-in., 1000-gpm, 500-ft-tdh vertical condensate pumps (one a spare). They deliver condensate through extraction heaters, maintain high NPSH on boiler feed pumps. Circulating water pumped from cooling tower by 2 vertical, single-stage, single-suction, volute-type centrifugals (Foster Wheeler Corp. photo)

Power Engineering

Above:—Modern incandescent and fluorescent street lights are tested inside this 75-ft chamber, which acts as a camera and focuses light on the test stand at the far end, where a General Electric engineer is adjusting a light intensity meter. The circular curtains or flanges keep the light from being reflected in the darkened chamber. It is located in the G-E Illuminating Laboratory at Lynn, Mass.

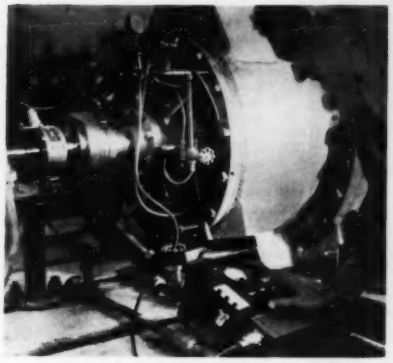


Above:—On a strip of land between sea and Shoreham Canal, Brighton, Sussex, England, this $42,000,000 power plant is rising. It is Brighton B, one of four new power stations being developed to full capacity, in this case 315,000 kw. Shoreham Harbor is being enlarged to allow coal barges to unload direct to the station. At left, one of the 350-ft chimneys is shown under construction. Overall dimensions of the finished job: 900 ft by 300 ft. (British Information Services photo)

Below:—Like some great mollusk lies this huge 117-ton scroll case, through which 80 tons of water will rush every second to spin the first 105,000-hp turbine in the Hungry Horse power plant. Two turbines will be installed this year to permit installation and energization of the first two 71,250-kw generators in 1952. Scheduled for completion late in 1953, the big Bureau of Reclamation dam and power plant will have a capacity of 285,000-kw in four generators

Below:—Hundreds of spectators at the Walter Kidde Proving Ground saw this technician extinguish a roaring electrical transformer fire in two seconds with dry chemical from a 20-lb portable extinguisher. This was one of many acts performed at the Kidde fire fighting demonstration held recently in an attempt to reduce the staggering annual fire loss in the United States, which last year consumed an estimated $770,000,000 of property and killed 10,000 people

NEWS REEL

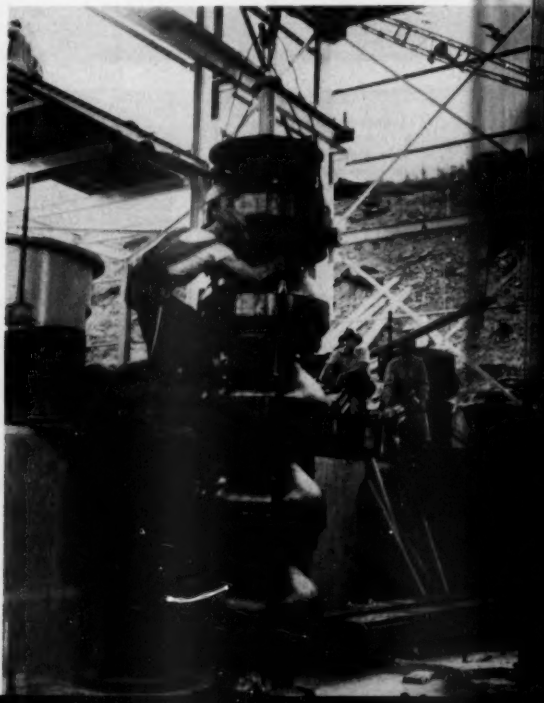


Above:—To better the convenience and the speed of performance measurements made in designing pumps, the Research and Development Department of Worthington Pump and Machinery Corp. has supplemented dynamometers with new type torque measuring instruments. These utilize the Baldwin SR-4 bonded resistance wire strain gages. This photo shows an experimental test set-up for a single stage of a boiler feed pump

Above:—Flying Saucer? No, it's a 27,000-lb, 120-in. bronze-rimmed cast-steel leaf for a butterfly valve being manufactured in the Sunnyvale, Calif. plant of Westinghouse Electric Corp. The valve will control flow of water through a penstock leading to a big waterwheel generator in a Southern California hydroelectric power generating station. Holes are on downstream face of leaf; upstream face is solid cast steel. Four protruding "legs" are steel supports, temporarily welded to the structure to speed machining and other manufacturing operations

Below:—On the office building at 1350 Broadway in New York City, two vertical lines are chilled water risers for new 800-ton air-conditioning system installed during modernization of building. They are enclosed in stainless steel jackets, save interior space, simplify air conditioning of older buildings, say the engineers, Jaros, Baum & Bolles. Building purchases 8,500,000 lb of steam a year from New York Steam Corp., uses it in steam-turbine-driven compressors and auxiliaries. (New York Steam Corp. photo)

Below:—Installing one of six 2500-hp Peerless vertical, close-coupled pumps, during construction of new 100 mgd emergency pumping plant of the City of New York, on the Hudson River at Chelsea, N. Y. These pumps, claimed to be largest of their kind in the world, consist of 5 stages, with 36 in. diameter bowls, rated at 14,000 gpm each against 600 ft head. This emergency pumping plant was built to aid in forestalling effects of drought that handicapped New York City in 1949



65,000-Hp

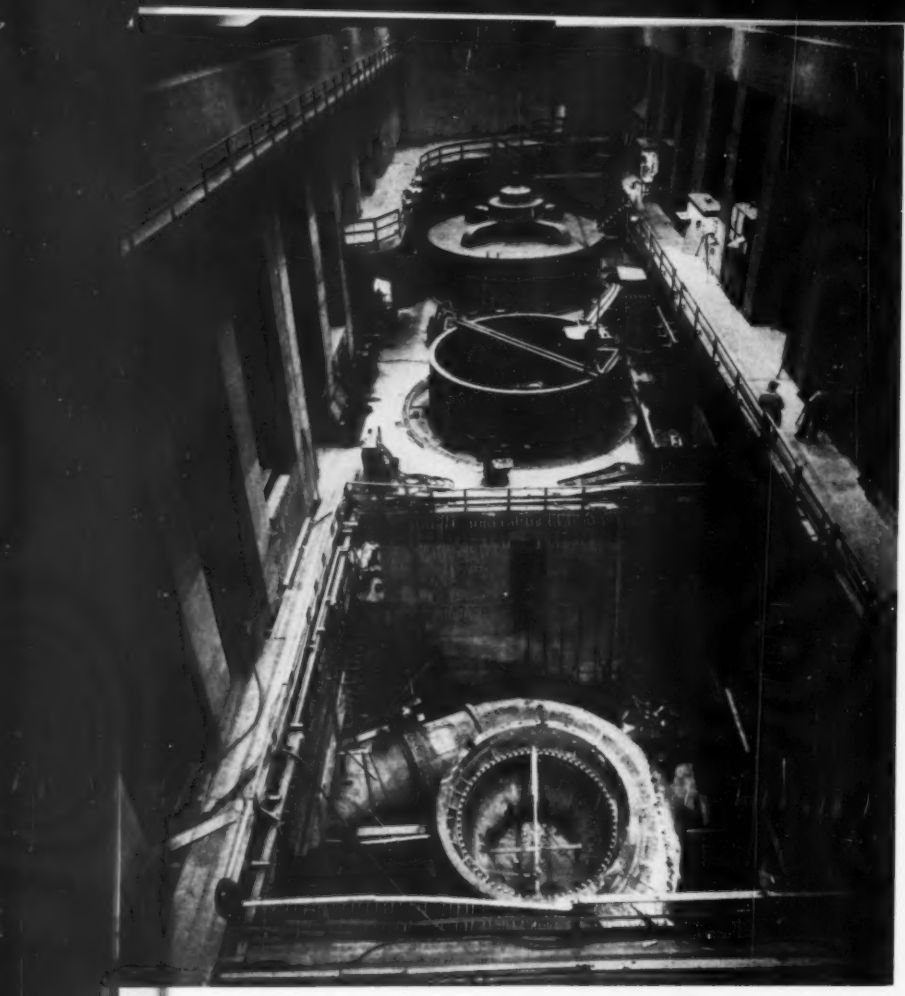


Fig. 1. Interior of Grand Coulee pumping plant, showing first three pumping units under construction. Unit P-1 at far end is complete and in operation. Unit P-2, center, has been completed since this photo was taken. Unit P-3, foreground, shows part of pump casing, which is buried in concrete as unit is assembled. Bureau of Reclamation has let contracts for first 6 of ultimate 12 pumping units

Pumps are single-stage, vertical shaft units, each rated 1350 cfs at 310 ft head, 1600 cfs under 280 ft head. Pumps are set on 45-ft centers, but discharge pipes converge as they leave pumps and are on 14 ft 6 in. centers at top of lift, Fig. 2. Pumps designed and furnished by Byron Jackson Co. and Pelton Water Wheel Co., under joint contract, built in the latter's shops

First two motors to be installed built by General Electric Co. Each is rated 65,000 hp, 1.0 pf, 3 phase, 60 cycle, 13,600 v, 200 rpm. Next four similar motors are being built by Westinghouse Electric Corp. They are attached to the pump shafts by rigid flange couplings

Units have upper and lower guide bearings, rotor brakes, and thrust bearing supporting weight of all rotating parts plus unbalanced hydraulic thrust. Thrust bearing is GE spring type—smooth runner on shaft, bearing on spring-supported segmental babbitted stationary plates. High-pressure oil introduced in center of stationary segments forms oil film for starting, to reduce motor starting torque

Fig. 2—Lower Left. Grand Coulee pumping plant behind Grand Coulee dam; end of left abutment of dam shows in lower right. Pumping plant, just upstream from dam, lower center, from which 12 steel pipes carry water up 280 ft to empty into 1.8-mile feeder canal, which in turn empties into Grand Coulee, abandoned ice-age channel of Columbia River, which becomes 27-mile storage reservoir for irrigation. Once up the hill into the canal, water flows by gravity to irrigation channels

Fig. 3.—Lower Center. Workman attaching pump shaft to impeller of one of pumps. Impeller is 5 ft 8½ in. high. At top it is 14 ft in diameter, at bottom 8 ft. It has seven vanes, weighs 30 tons

Fig. 4.—Lower Right. Closeup of GE crew setting 109-ton rotor of 65,000-hp motor on Unit P-1. Rotor has less than 1 in. clearance in stator. Stator was in 4 sections, was set up on base over pump and stator winding completed after stator was in its permanent position. Rotor assembled in unoccupied pit, then handled by two cranes with equalizer and lowered into stator

Grand Coulee Pumps Begin Operation

World's biggest pumps driven by world's biggest motors . . . First pump put into service in June . . . Plant will ultimately have 12 motor-driven pumps, each of 1,000,000,000 gpd capacity at 280 ft head, each driven by a 65,000-hp motor . . . They deliver water for irrigation from Grand Coulee reservoir to 1,029,000 acres in Columbia River basin in central Washington . . . Everything at Grand Coulee is gigantic:—biggest concrete structure ever built (12,500,000 cu yd):—biggest hydroelectric generators, 165,000 hp each (18 of them):—now world's biggest pumping plant

FIRST PUMPING UNIT of the gigantic Grand Coulee pumping plant was placed in operation on June 14, 1951, by Michael W. Straus, commissioner of reclamation, with Interior Secretary Chapman participating by phone from Washington.

The pumping plant, an integral part of the Grand Coulee development from the beginning, is designed to house an ultimate of 12 pumping units of the types shown here. These pump water from the reservoir behind Grand Coulee Dam for irrigation of a vast area. Ten of the twelve pumps, it is expected, will meet the water requirements of the irrigation system, leaving two for spares and standby.

To engineers, one of the most important features of the Grand Coulee pumping plant is its method of operation. Six of the nine hydroelectric generators in the left power house were designed specifically for pumping duty, with motor-driven exciters instead of shaft-driven exciters. Each of these six generators is connected electrically, by the buses shown in Fig. 5, to two of the pump motors. Each generator has a nameplate rating of 108,000 kw, but a capability of 120,000 kw with high water on the hydraulic turbines.

The pump motors can be started as synchronous motors or as induction motors. To start as a synchronous machine, the generator, at rest, is connected to the 13,800-v buses leading to the pump motor; field circuits of both generator and motors are closed; exciters are running at normal speeds, and pilot exciters are developing normal voltage; but field circuits of both exciters are open. Field rheostats of generator and motor have been adjusted to proper position. Circuit breakers of pump motors and those of main exciter fields are then closed. Then the hydraulic turbine is started and the motors come up to 60-cycle speed in step with the generator.

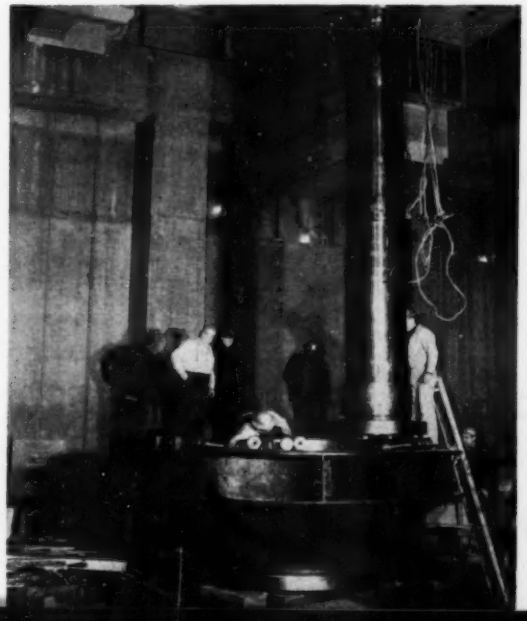
To start a pump motor as an induction machine, turbine gates are adjusted so that generator is run at about 70 per cent of normal speed with its field circuit open, while motors, with open field circuits, are at rest, and not connected to generator. Exciters of both generator and motors are running at normal speeds, but field of generator exciter, and motor field circuit breakers, are open.

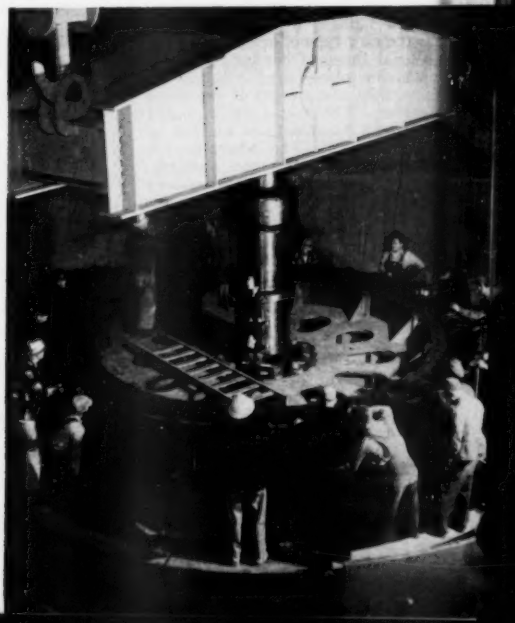
A control switch in turbine-governor cabinet is closed to start motors. Field rheostats of generator and motor exciters are set in proper positions for starting. Motor circuit breaker and field of the generator exciter are then closed. As accelerating motors and decelerating generator approach synchronism, motor fields will be closed. After synchronizing generator and motors, turbine gates, which were left at initial setting during the starting period, are opened to bring units to normal speed.

Since it causes less shock to the generating and pumping units, the synchronous method will be used ordinarily; for quicker start, the induction method.

Fig. 5. Bus bars carry power from each of six 108,000-kw hydroelectric generators, in power house downstream from dam, to two of the 65,000-hp pump motors upstream behind dam. Bus bars are hollow copper tubes 7½ in. in diameter, enclosed and insulated inside cylindrical aluminum housing 21 in. in diameter. Bars are carried up face of dam near left abutment in bus runway of concrete and aluminum

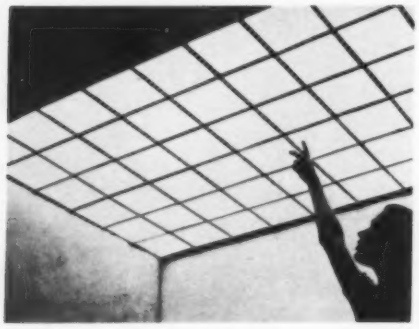
Photos and data courtesy U. S. Bureau of Reclamation





Electro-Luminescence—

New Light Source—"Sandwich" of Light



Electro-luminescence is the creation of light by the excitation of certain materials placed in a fluctuating electric field. While the principle has been known for some time, it was only recently that a practical method of using it was developed at Sylvania Electric Products Laboratories. The unique advantage of this method of producing light lies in the fact that large luminous areas of low or moderate intensity can be produced. At the left is shown a luminous ceiling, only an eighth-inch thick and six feet wide. A small transformer brings the house current up to 500 volts but the entire ceiling uses less than 75 watts.

AS ANNOUNCED in the popular press, Sylvania Electric Products, Inc., recently demonstrated a new method of producing light, based upon the principle of electro-luminescence. This development, entirely different from either incandescent or fluorescent light, uses thin white sheets of glowing glass. Sheets of this glowing material can be made in almost any size to provide luminous ceilings, walls, tables, clock faces, stair risers, switch plates, and signs. This *area* light source, which has been the goal of lighting engineers and architects for many years, is a luminous kind of condenser which Sylvania calls *Panelite*.

Dr. E. F. Lowry, head of the development group which perfected the new lighting principle, revealed that the new type of lamp consists of a special sheet of conductive glass, on which is placed a *phosphor-dielectric* coating, and a layer of vaporized aluminum. These two coatings add less than a hundredth of an inch to the glass itself. The edges of the phosphor coating are connected directly to an alternating current power source. For low luminous intensities a 110-v source can be used but where greater brightness is desired voltages of 400 to 500 are needed. Since the current consumption is low, the higher voltage can be obtained by means of a small step-up transformer.

Electro-luminescence

Historically, the first and still most widely used method of producing light depends upon the phenomenon of incandescence. Another method of considerable importance, since it is the method used in the neon and other types of gaseous lamps, involves the excitation of resonance by the passage of electricity through a gas or vapor. This second method may also include the phenomenon of the fluorescence of solids exposed to these radiations. The latter, of course, is used in the fluorescent lamp.

A third method of converting energy into light involves electro-luminescence and this is the principle used in the new Sylvania development. This involves neither incandescent nor gaseous discharge phenomena.

When certain materials are placed in a fluctuating electric field under proper conditions, they are excited to luminescence and continue to emit light as long as the exciting field is maintained. This constitutes the phenomenon of electro-luminescence — not to be confused with cathodo-luminescence. No intermediate phenomenon such as glow or arc discharge appears to be involved. The materials luminesce directly under the influence of the electric field which must, however, be in the process of changing in intensity.

Electro-luminescence may be produced through a device which comprises a film of phosphor dispersed in a dielectric and placed between two conducting plates. At least one of these plates should be light transmitting so that the light generated can emerge. Such a device may be regarded as a luminous capacitor.

This principle has been known for some time but until the work done at Sylvania no practical application has been made. In the Sylvania method a coating of phosphor sus-

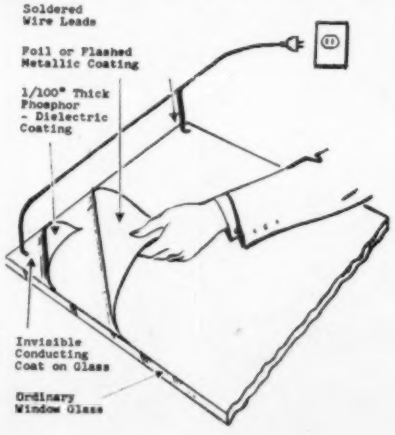


Fig. 1. This drawing shows how the Electro-Luminescent sheet is made

pended in a suitable solid dielectric is spread uniformly over the conducting surface of a *conducting* glass. The surface of the phosphor-dielectric film is then coated with a metallic conductor, except for a narrow strip around the edge of the plaque. One effective method of applying this film is to coat the dielectric with vaporized aluminum. Suitable connections are then made along one edge of the conducting glass to any convenient spot on the metallic backing layer.

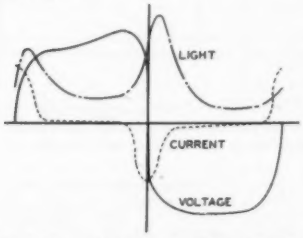


Fig. 2. Curves showing how the light output of a luminescent (condenser) lamp depends upon the rate of change of voltage

A number of substances have been found which can be excited to a greater or lesser degree in this device. Some are also fluorescent under ultraviolet or cathode ray excitation, some are phosphorescent, and some are neither. No direct correlation has been observed between the luminescence of a phosphor excited by the electric field and that resulting from ultraviolet or cathode ray excitation.

Action Result of Changing Field Intensity

The emission of light in this manner depends upon a fluctuating field intensity. A brief flash of light may be observed when a d-c potential is applied to the plaque and another when the charge is permitted to leak off, but no light at all is emitted as long as the d-c potential is maintained. A graphic way of demonstrating this behavior is shown in Fig. 2. In this experiment the output of a square wave generator was applied to the plaque terminals. Simultaneous cathode ray tube graphs were taken of the applied voltage and of the light emitted. It is obvious that luminescence occurs when the potential is changing. Short bursts of light are emitted which are practically in phase with the voltage changes at the end of each half cycle.

Similar tests were run using a 60-cycle sine wave source of supply. In these tests, it was possible to determine with considerable accuracy the phase relationships between voltage, current, and luminescence. Figure 3 is a graph which demonstrates the fact that the light emitted is in phase with the power absorbed by the dielectric. It is apparent that the current leads the voltage by nearly 90 deg. Most of the luminescence occurs when both voltage and current are in the same direction although in different quadrants. This of course is the period when the capacitor is absorbing energy. Very little light is emitted when voltage and current are in opposite directions. In other words, the light emission is in phase with the positive half of the power curve.

Several factors affect the intensity of the light emitted. The thickness, the resistivity, and the dielectric constant of the phosphor layer are all important, as are the voltage and frequency at which the device is operated.

Fig. 4 illustrates the relation between light output and voltage for a typical luminous capacitor operated at 60 cycles per second. The threshold of visibility is at a potential of the order of 25 v. The brightness of the lamp increases rapidly with the voltage over a considerable range of potential until a limiting voltage is reached. This limiting potential is that at which breakdown of the dielectric occurs.

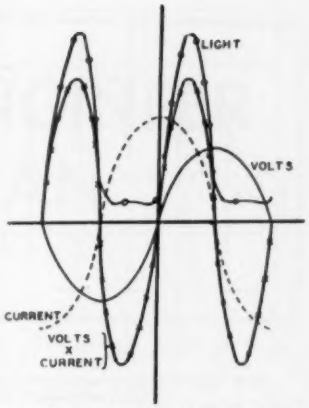


Fig. 3. Curves showing the phase relationships of light output, voltage, current and voltamperes

Light Intensity Function of Frequency

At a given voltage the light output increases with frequency as shown in Fig. 5, Curve A. In the test upon which Fig. 5 is based, a variable frequency generator was connected to the conducting plates of the lamp and a constant voltage of 100 v was applied. The light output was meas-

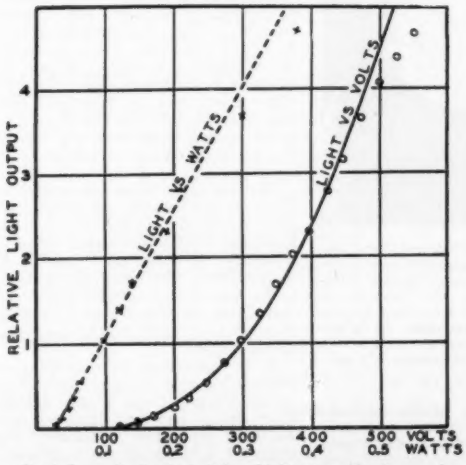


Fig. 4. Curves showing the variation of light output with voltage and wattage for a luminescent lamp

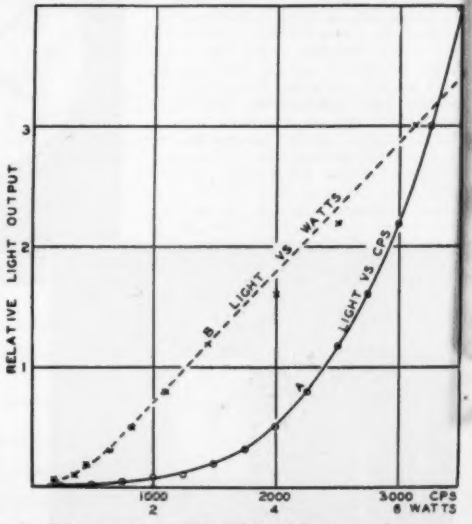


Fig. 5. Curves showing variation of light with frequency and wattage consumed

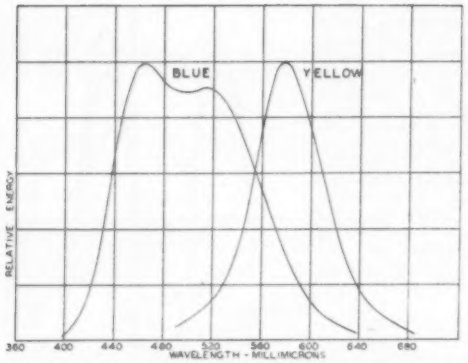


Fig. 6. Spectral energy curves for blue and yellow electro-luminescent lamps as discussed in the text

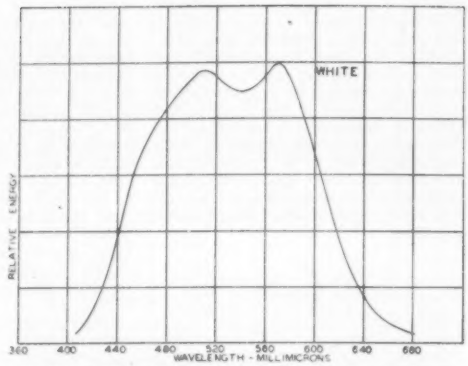


Fig. 7. By combining the two colors in proper proportions white lamps may be made which have a spectral energy curve like this

ured as the frequency was varied between 50 and 3500 cycles per sec. There is some discrepancy to be accounted for in the neighborhood of 50 cycles, possibly due to some resonance effect in the generating equipment, but with this exception the light output increases with frequency. Curve B of this figure is of equal interest and of some theoretical significance. This curve shows the relation between light output and wattage consumption at different frequencies. The linearity of this relation over nearly the whole range of frequencies suggests that a given amount of light is emitted each time the capacitor lamp is charged to a given potential or, in other words, each time a given quantity of electricity is stored in the capacitor lamp. The more times per second this is accomplished, the more light will be emitted. This, of course, agrees well with quantum considerations.

These results differ from those reported by Leverenz who performed some experiments with phosphor films furnished him by Destriau as well as with phosphor films prepared in his own laboratories. He states that these films were found to glow feebly blue (barely perceptible to the partially dark-adapted eye) under applied 110-volt alternating current. Leverenz believes that this glow is that characteristic of breakdown ionization of atmospheric nitrogen on the assumption that the electric field may produce a breakdown of thin air films surrounding the phosphor particles in the organic film.

Whatever may have been the situation in the experiments performed by Leverenz, the results which we have obtained prove that his conclusions are not applicable to the devices described here. If the light obtained from our lamps were associated with glow discharge phenomena, it should be even more intense on d-c than on a-c whereas there is no light emitted at all on sustained d-c potentials of the same value as the a-c voltages used. All phosphors capable of being excited by ultraviolet should emit some light of their characteristic color. Only certain phosphors exhibit electro-luminescence. If glow discharge phenomena were responsible, the luminosity should be in phase with the current. It definitely is not. The lack of a glow discharge in these lamps is also evident from the fact that the current leads the voltage by a large phase angle. Furthermore, the higher the dielectric constant and resistivity of the medium in which the phosphors are embedded, the greater the light intensity at a given voltage or, conversely, the lower the voltage at which a given luminosity may be obtained.

An explanation has been advanced by Garlick that light emitted under field excitation is a phosphorescence resulting from the lifting of electrons from deep traps. This explanation may have some theoretical merit although it seems rather difficult to visualize in view of the fact that in some of our experiments lamps which had been kept in complete darkness for as long as three days luminesced at normal brilliance immediately upon application of the proper voltage. Other luminescent (condenser) lamps have been operated continuously in a light-tight box for as much as 16 hours with no appreciable diminution of their light output. In this latter case, the phosphorescence must have been self-excited if the explanation referred to is accepted.

The useful life to be expected from these lamps has not yet been fully determined although some of them have now been in operation for some thousands of hours. After about 50 hr of operation, their light output seems to flatten off and remain fairly constant over considerable periods. Further data on both points are being accumulated.

It is interesting to note that no perceptible color change takes place on dimming but that a very definite color change has been observed with variable frequency operation. For example, a luminescent (condenser) lamp which luminesced in the yellow

(*Continued on page 88*)

Fig. 8 (Above). Lighted commercial clock with the new Sylvania "Panelite" principle. This operated at 500-v, and the picture was made solely with its own light at aperture F 2.3 with an exposure of 3 sec

Fig. 9 (Left). Illuminated switchplate can be permanently connected to house wiring to run 24-hr a day at a cost of about 3 cents a year

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

BIG BUT SIMPLE

TWO OF the motors for the new wind tunnel being built at the Arnold Engineering Development Center at Tullahoma, Tenn. will be the most powerful in the world, exceeding the 65,000-hp units at Grand Coulee Dam. To provide adequate speed control for these motors, which are being built by Westinghouse, it was necessary to build rheostats with greater capacity than any ever built before. Curiously enough, these large rheostats are relatively simple in design—they will be liquid rheostats, similar in principle to the water rheostats which almost every practical engineer and electrician has had to rig up one time or another. Only difference is in their size. Each of these two liquid rheostats is more than 20 ft high and consists of three 9-ft high tanks n which an alkaline solution is circulated. At the bottom of each tank is a stationary nickel-clad steel plate electrode. A similar electrode is attached to a movable plunger-like support at the top of the tank. Current passes from one electrode to another through the alkaline solution. As the top electrode plate is lowered the current is increased, thus speeding up the motor. Pulling the plates farther apart reduces the current. The three moving electrodes are hooked together so the three tanks operate as a single unit. These liquid rheostats are part of twenty million dollars worth of equipment which Westinghouse is building for The Arnold Development Center.

Wind tunnels, strange as it may seem, require motors so large that special studies have to be made to insure adequate supplies of power. At Moffett Field, Calif, for example, the new supersonic wind tunnel will require motor capacity totaling 180,000 hp. For this installation, General Electric is supplying four 45,000-hp variable=speed induction motors, mounted in tandem on a single shaft to drive either of two axial-flow compressors.

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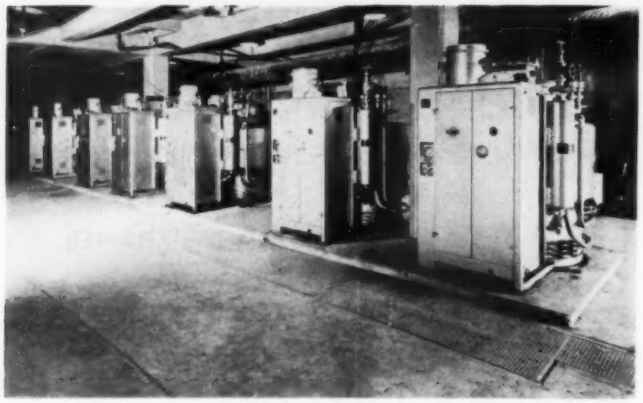


Fig. 1. Seven steam generators installed in the new Union Pacific Railroad laundry in Ogden, Utah. These machines are like the steam generators installed in Diesel locomotives to heat the train

Diesel Steam for a Laundry

UNIQUE METHOD of heating water for laundering purposes is being employed at the new Union Pacific Railroad laundry now being built at Ogden, Utah.

There a battery of seven steam generators can heat up all the water needed in minutes from the time they are fired. This method of heating, supplanting the usual type boiler installation, will permit handling of 3300 lb of dry laundry every hour. This means that 13,333 pieces of dirty laundry will be unloaded at the south end of the newly erected building, and within an hour and a half it will come out at the other end of the building, washed, dried, folded, counted and tied in bundles ready for delivery to the commissary across the street.

Plenty of Steam—Quick!

The steam generators, manufactured by the Vapor Heating Corporation of Chicago, were designed originally for heating passenger cars on diesel powered trains. There are seven of the units installed in the new Union Pacific laundry and each unit is capable of making over 4500 lb of steam per hr, a total of over 31,500 lb, enough to heat 96 five-room houses in zero weather. The speed with which they can be put into operation is illustrated by the fact that each machine can develop a steam pressure of 250 psi in two minutes from cold water; about 100 psi will be used in the laundry.

Each generator is fired with a hot atomized Diesel fuel oil fire and is completely automatic in operation from one-third to full capacity. A specially-designed steam pressure switch turns on the fire in one or more units when steam pressure in the line is down and shuts down when the line pressure is high. Each machine has an electric eye to turn the unit off if the fire does not light up properly. Boiler safety is assured, according to manufacturers' representatives and safety inspectors, because no reservoir of water is heated under pressure. Hot gases from the Diesel-oil fire heat the seamless steel tubing through which water is pumped. There is a total of 702 ft of steel tubing coiled up in each generator.

If the pressure rises, steam generators are turned off one at a time until the output is matched to the

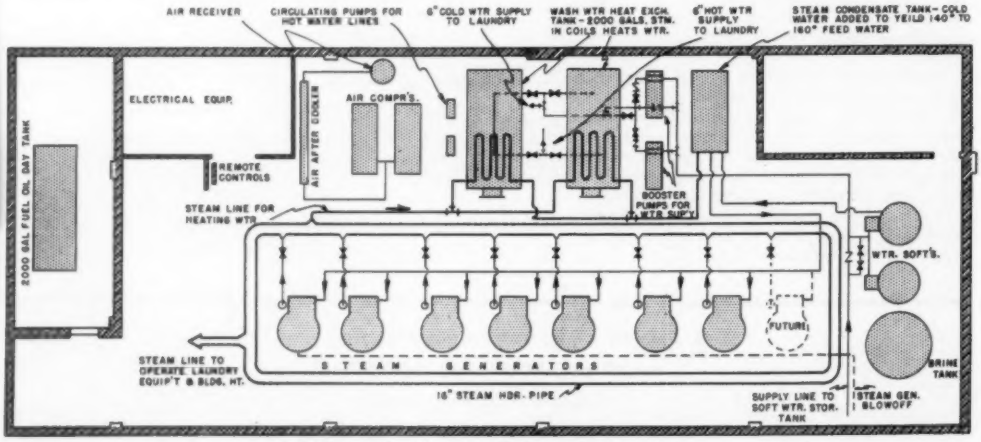

AIR RECEIVER
CIRCULATING PUMPS FOR HOT WATER LINES
6" COLD WTR SUPPLY TO LAUNDRY
WASH WTR HEAT EXCH. TANK - 2000 GALS. STM. IN COILS HEATS WTR.
6" HOT WTR SUPPLY TO LAUNDRY
STEAM CONDENSATE TANK - COLD WATER ADDED TO YEILD 140° TO 160° FEED WATER
ELECTRICAL EQUIP.
AIR COMPR'S.
AIR AFTER COOLER
2000 GAL FUEL OIL DAY TANK
REMOTE CONTROLS
STEAM LINE FOR HEATING WTR.
BOOSTER PUMPS FOR H. WTR SUPY
WTR. SOFT'S.
FUTURE
STEAM LINE TO OPERATE LAUNDRY EQUIP'T & BLDG. HT.
STEAM GENERATORS
16" STEAM HDR. PIPE
SUPPLY LINE TO SOFT WTR. STOR. TANK
BRINE TANK
STEAM GEN. & BLOWOFF

Fig. 2. Floor plan of the laundry showing the steam generators

These steam generators were originally developed to be installed in Diesel locomotives to supply steam for the heating of the passenger cars. However, the versatility and completely automatic control of the units make them well adapted for industrial use where moderate amounts of steam are needed in a hurry as in this Union Pacific Railroad laundry. Each generator will produce over 4500 lb of steam per hr and will develop full working pressure of 250 psi in 2 min from a cold start. The automatic controls function so that each unit produces steam only when required

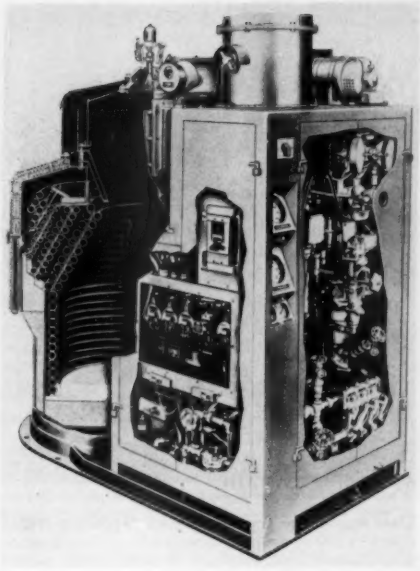


Fig. 3. Cut-away view of one of the generators. The oil burns at almost 3000 F releasing 1,000,000 Btu per cubic foot of volume

load requirements. Each steam generator is controlled by a separate fractional-horsepower-motor-driven switch assembly to insure that it is properly started and stopped. When taking a unit off the line, first the fuel is turned off, then the coils are automatically filled with water, then the motor turns off, leaving each unit ready to be fired up.

Wires to steam generators are combined in separate cord and plug sets for each unit so that the sequence in which the units are called upon can be readily varied, thus equalizing the wear between steam generators and making it very simple to disconnect one unit for servicing. If for any reason a unit should fail to work when called upon, the master control will cause an alarm to be given and pass on to the next steam generator.

Designed to Heat Diesel Trains

The generators were originally designed for heating passenger cars on the Union Pacific's City of Portland, the country's first Diesel streamliner, put into service in 1936. Now hundreds are used on 78 different railroads in the U. S. and other countries. The units are installed up in the Diesel locomotives.

Steam to be Used Several Ways

At the Ogden laundry, the generators will be used not only to heat the water to 180 F for laundering purposes, but to heat the building in the winter. Steam developed by the generators will also be used in operation of the washers, ironers and pressers. The basement of the building will hold two large heat exchanger tanks, each of 2000 gal capacity. The steam not used in presses will be condensed and regenerated. 13,000 gal of water will be used every hour. Because of the heat generated in laundering operations, the railroad must also include a ventilating and air-conditioning system which will change the air throughout the building every 90 sec.

Installed will be eight washers, three extractors, four flatwork ironers, three dryers, twelve tumblers, forty-two press units, six folders, one stacker, three tying machines, two continuous belt conveyors and a mono-rail system for moving baskets of laundry.

The new plant will take care of linen from all Union Pacific passenger trains, Sun Valley and hotels and restaurants of the system with the exception of the southern Utah parks property of the railroad. A complete dry cleaning system in the plant will handle drapes and uniforms for the entire railroad.

Many other uses have been found for the machines with their steam-developing capacity and over 80 per cent efficiency. They are used for pile driving, steam hoists, concrete block plants, ready-mix concrete, chemical processing and a number of other uses where steam is needed in a hurry.

Engineering for the laundry was done by Union Pacific and Vapor engineers under supervision of W. C. Perkins, Chief Engineer of the Union Pacific Railroad. L. W. Ashton is U. P. R. Engineer on location. Vapor engineers were N. O. Kirkby and J. E. LaRocque. Construction was done by Larson Construction and Engineering Company, Ogden, Utah.

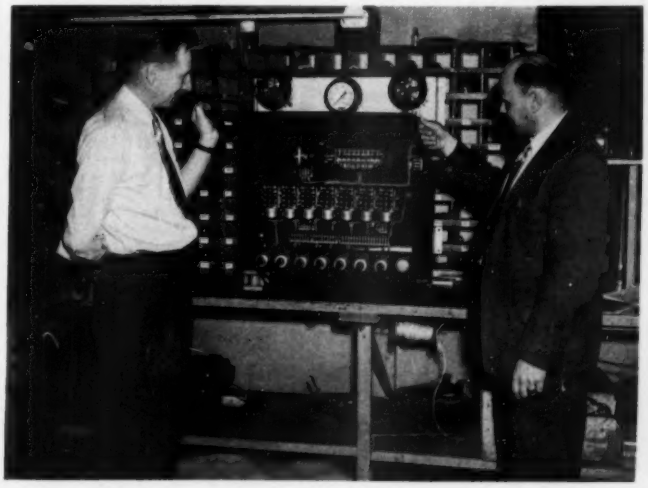


Fig. 4. The especially-designed master control panel which is used to selectively control the seven units on the basis of load requirements. Two mercury type pressure switches at the top are set for upper and lower limits of 100 psi and connected to switch additional generators on if the steam pressure drops. An arrangement exists for changing the sequence of generator operation

What Motor for What Pump?

Centrifugal pumps may resemble each other but beneath their casings are to be found a variety of characteristics which greatly influence the type and character of the driving motors required. It is very important, therefore, in selecting pump motors to have accurate data concerning the pumps characteristics. This discussion of the subject by Mr. Oscarson of Electric Machinery Mfg. Company will provide you with valuable data concerning the characteristics of various types of pumps and the types of motors to drive the various pumps

By G. L. OSCARSON,

Chief Application Engineer, Electric Machinery Mfg. Co., Minneapolis, Minn.

THE TERM *centrifugal* pump as usually used covers a multitude of designs and types. A centrifugal pump may be a radial flow machine or it may be an axial flow or a mixed flow unit but in all types the basic principle involves the addition of energy to the flowing liquid by the pressure differences created by the vanes of a rotating impeller or propeller. Since certain characteristics of the mixed-flow and axial flow pumps differ widely from the corresponding characteristics of radial flow pumps, and since these characteristics may greatly affect the torque characteristics of the machines, it is important that the pump type be accurately defined before it becomes possible to select a proper drive motor.

Starting torque requirements for any of the centrifugal pumps mentioned are quite moderate. Ten to twenty per cent of full-load torque will usually suffice to start these pumps from rest. Assuming free flow conditions, that is open discharge and no appreciable static head, for any steady state condition (assuming that neither the water column nor the pump is accelerating) the torque will vary as the square of the speed. This is illustrated by the curve, Fig. 1, where it is assumed that 16 per cent of full-load torque will suffice to start the pump turning. As the pump starts to turn the torque drops to about 10 per cent of full-load torque and then follows a *squared* curve to 100 per cent at full speed. The dotted curve shows typical torque requirements for a radial flow pump with closed discharge valve.

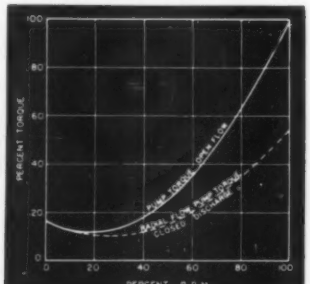


Fig. 1. Torque varies as the square of the speed. Under free flow conditions the torque required by a centrifugal pump will vary as the upper square curve. With closed-discharge the torque will vary widely with the speed. The lower curve is for a radial-flow centrifugal pump

Type of Impeller

The type of impeller used will vary widely depending on the volume to be pumped and the head to be pumped against. In Fig. 5 are shown cross-sections of several types of centrifugal pump impellers. Numbers 1 to 4, inclusive, are radial-flow pumps varying from low capacity, high head at 1, to high capacity, low head at 4. In all cases the discharge is radial, at right angles to the shaft. Characteristic high-head capacity curves, at 100 per cent of rated speed, for these units are shown in Fig. 2.

No. 5 is the cross-section of a mixed flow impeller. As indicated by the arrow, the direction of water flow, at discharge from the impeller, is at approximately 45 deg to the axis of the shaft.

No. 6 illustrates the impeller of an axial-flow type of pump. Fundamentally this is a propeller, and the direction of water flow is parallel to the shaft.

One of the fundamental factors in centrifugal pump design is the *specific speed*. As will be noted in the illustrations, the specific speed of this group of pumps varies widely. It is quite low for radial-flow pumps and runs to a high figure in the axial-flow type.

Mathematically,

$$N_s = \frac{NQ^{1/2}}{H^{3/4}}$$

Where N_s = specific speed
N = rpm
Q = gpm
H = Total head in feet;

where the values of Q and H correspond to the conditions at which the maximum efficiency is obtained. A popular, physical explanation is that the specific speed, N_s, of any pump is the speed at which an imaginary, geometrically similar pump, working at its maximum efficiency point, would have to operate to deliver 1 gpm against a total head of one foot. On large volume, low head units the tendency is to go to high specific speeds in order to reduce the physical size of the pump, and, due to the higher speed, the cost of the driving motor.

As will be noted from the characteristic curves in Fig. 2, the head developed, at shut-off (closed discharge valve) increases with the specific speed of the pump, reaching about 300 per cent of normal on an axial flow unit.

Closed-Discharge Torque Requirements

Of considerable importance in synchronous motor applications, is the brake horsepower required by the pump under shut-off conditions. These values are covered in Fig. 3.

It will be noted that for mixed-flow or axial-flow pumps, the horsepower, and therefore the torque at full speed, is more than full-load value when operating under closed-discharge conditions. Such pumps are therefore always started with open discharge. However, even so, if a long discharge line, with considerable hydraulic inertia is involved, the torque during the accelerating period may be more than otherwise expected.

On the other hand, radial-flow pumps require less than full-load torque when operating against closed discharge. For that reason they are often started under shut-off conditions to permit easier starting.

In radial-flow, and some mixed flow pumps operating against closed discharge a "doughnut" of water circulates around the pump with the pump impeller. The shear action between the stationary and moving volumes of water requires force to overcome it. There is also some recirculation of water back through the impeller. As a result heating is caused. Continued operation would result in damage.

In mixed-flow or axial-flow pumps, operating under shut-off conditions, some water is actually displaced by the turning impeller and, being in-

compressible, all of this water must return from the discharge portion of the pump to the suction side between the rotating impeller blades. This results in violent turbulence and a high torque requirement.

Torque Factors Widely Variable

Many factors are intimately bound up in the determination of adequate motor torques for centrifugal pumps. Important ones are — motor torque curve, starting voltage conditions, pump torque curve, inertia of rotating mass, hydraulic conditions, including inertia of water column, permissible synchronizing time.

The motor torque curve, corrected for voltage during start — less the torque required by the pump, based on certain hydraulic assumptions, will determine the net accelerating torque. This torque — equated against inertia — will determine the length of time necessary to reach any given speed. After a preliminary determination of this time, it may be necessary to revise original assumptions, and recalculate starting time.

In the application of synchronous motors to centrifugal pumps the important considerations are: (1) to provide sufficient net accelerating torque at all speeds to obtain a satisfactory rate of acceleration; (2) to provide sufficient torque at pull-in speed to match the pump requirements; (3) to provide sufficient motor capacity to operate the pump continuously after synchronism is attained.

Special engineering analysis is required on medium and low speed units on account of the pump characteristics and inertia values involved. Also because medium and low speed motors inherently have low torque valves. High starting, accelerating and nominal pull-in torques increase the size and cost of such motors appreciably. On the other hand synchronous motors for high speed pumps, which are usually of the radial flow type, inherently have low-inertia values and adequate starting and pull-in torques.

In general, the following nominal pull-in torque values may be considered satisfactory for preliminary determination of motor frame sizes, weights, etc.

Type of Pump	Nominal Pull-In Torque (Per Cent of Full-Load)
Radial flow	
600–3600 rpm	
Closed discharge	70
Open discharge	110
Below 600 rpm	
Closed discharge	90
Open discharge	125
Mixed flow (open discharge)	140
Axial flow (open discharge)	160

Squirrel-Cage Motor Application

There is usually not much problem in obtaining sufficient starting and accelerating torque in squirrel-cage motors applied to centrifugal pumps. The starting torque will usually be at least 100 per cent and the torque curve usually has a rising characteristic to at least 200 per cent in the neighborhood of 85 per cent speed. Even on reduced voltage starting the torque available will be ample.

On two-pole and four-pole squirrel-cage induction motors, designed for low starting kva, some degree of caution must be exercised. Figure 4 illustrates motor torque curves for a four-pole motor designed for low starting kva and high efficiency. The starting torque is 80 per cent, dropping to slighting over 60 per cent at 40 per cent speed and reaching 200 per cent at about 90 per cent speed. Curves also show the torque values for 90, 80 and 70 per cent voltage values during starting.

The lower curves show the pump torque required on open discharge for any type of pump and on closed discharge for a radial flow type of pump. As will be noted, with open discharge starting, and 70 per cent of full voltage applied, the motor would not accelerate beyond 60 per cent. On closed discharge with a radial flow pump there would be no problem whatever. However if an attempt were made to start a mixed-flow or axial-flow pump on closed discharge, with reduced voltage starting on the motor, the motor would probably not accelerate beyond about 50 per cent speed.

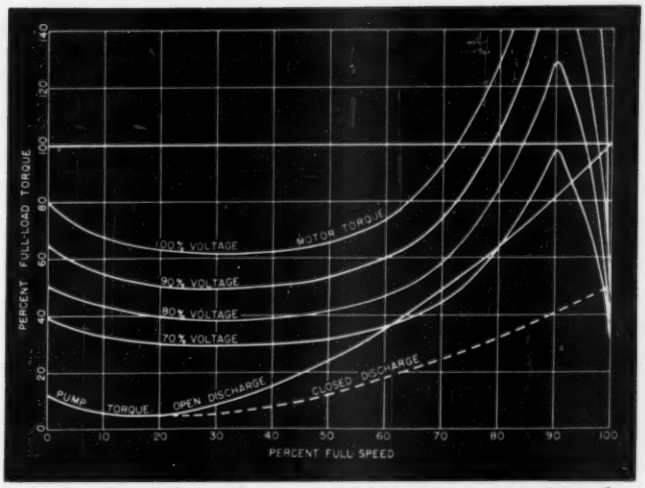


Fig. 4. Motor torque curves for radial-flow pumps accelerating torque curves at various voltages for a 3000 hp, 1780 rpm, squirrel cage induction motor driving a radial-flow centrifugal oil pump

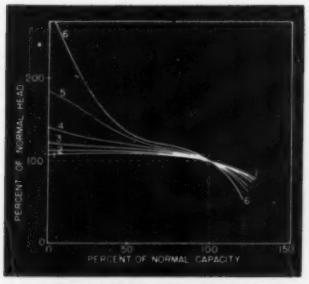


Fig. 2. Head Characteristics

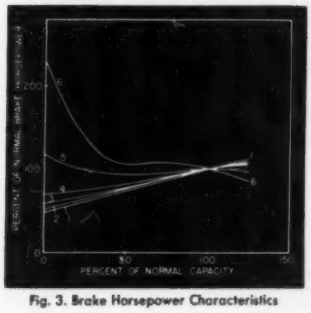


Fig. 3. Brake Horsepower Characteristics

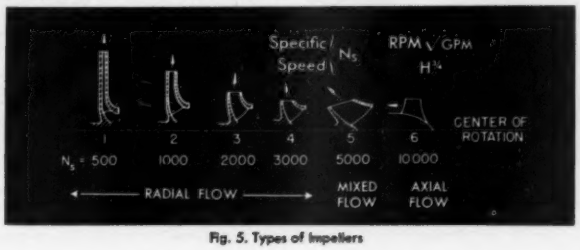


Fig. 5. Types of Impellers

Where low starting kva is required, say on the order of not more than 150 per cent of full-load kva, it is usually necessary to use wound-rotor motors. These motors will develop a starting torque of 100 per cent full-load torque with a kva inrush of not over 150 per cent, and by changing secondary resistance values as the motor comes up to speed, the torque can be maintained at a high value all the way to the operating speed. There is no torque problem in the application of wound-rotor motors to centrifugal pumps.

Wound rotor motors are quite frequently used where variable capacity is required. By inserting the proper amount of secondary resistance in the rotor circuit, either manually or automatically, speeds down to approximately 50 per cent of full load speed are available. The number of speed steps available and the accuracy of the speed control is adequate for many types of installations.

Magnetic Drives for Variable Speed

Where precisely controllable pump speeds are desired, or where synchronous motor drives are desired on account of power factor correction advantages, and variable output is still necessary, magnetic drives should be considered.

How To Apply Insulation on Steam Turbines

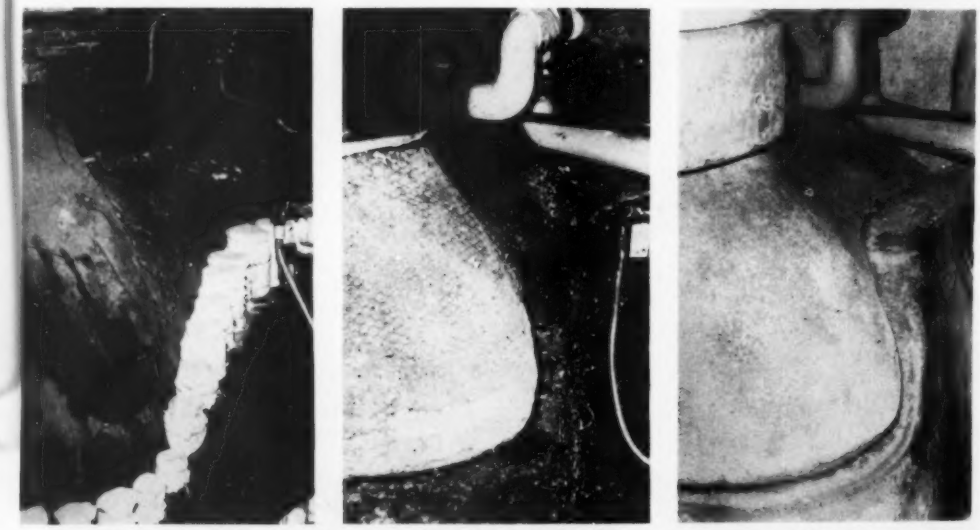
The insulation of irregular surfaces such as the casings of steam turbines requires care and proper insulating materials. This description of the methods used in insulating a turbine at Barbadoes Island generating station should prove helpful to engineers confronted with similar problems, who must know *how* as well as *why*

ALL SEASONED PLANT managers and engineers who supervise electric power generation know *what* high-temperature equipment is insulated and *why* insulation is necessary for efficient plant operation. Many, however, do not know enough about *how* insulation is applied and secured.

A knowledge of how heated equipment is (or will be) insulated helps the alert plant engineer to evaluate and specify the insulating materials and application techniques that will do the most effective heat-saving job for the longest time with no more than routine maintenance and repair.

Insulation of turbines, for example, requires an efficient insulating material that can be easily applied to irregular, hard-to-get-at surfaces. In addition, temperatures in different zones of a turbine vary considerably, and it is most economical to use an insulator whose thickness can be conveniently changed according to surface temperature. Because it fulfilled both these requirements, engineers specified mineral wool insulating cement on turbines driving the 60,000-kw generators at the Barbadoes Island generating station of the Philadelphia Electric Co.

Sequence photos A, B and C are close-ups showing the top of the high-pressure section of one of Philadelphia Electric's turbines. In the background is the highest tempera-



Three-step application of mineral wool cement on high-pressure section of a turbine at the Barbadoes Island generating station of the Philadelphia Electric Co. A (left). Bare turbine surface and 16-gage copper-weld tie wires twisted through ¼-in. nuts welded to surface on about 12-in. centers. B (center). First layer mineral wool cement, 3-in. thick, trowelled over surface and around asbestos-cloth-covered bolts. Wire mesh applied and fastened with tie wire on left. C (right). Second layer mineral wool cement, from 1-in. to 3-in. thick, trowelled into wire mesh and allowed to dry

ture zone of the turbine at about 950 F.

Mineral wool cement is applied to the turbine in two layers with 1-in. wire mesh secured by tie-wires over the first layer as additional support and as a key for application of the second layer. In the sequence photos, the three-step installation goes from bare surface and tie wires (A) to first layer and wire mesh (B) to second layer (C) which completes the job.

In photo A, the 16-gage copper-weld tie wires are twisted through ¼-in. nuts welded to the turbine surface on about 12-in. centers. Asbestos cloth has been wrapped and tied around the large bolts to facilitate later removal of the top section of the turbine for internal maintenance.

The first coat, 3-in. thick, of mineral wool cement (Photo B) is next trowelled smoothly over the surface and around the cloth-covered bolts. The tie wires can be seen protruding from the wet cement in the lower right. The dry mineral wool cement on the left in photo B has already been covered with wire mesh stretched to fit tightly and fastened with the tie wires. For best results, the first layer should be completely dry before application of the second layer.

In photo C, the second layer has been carefully trowelled into the wire mesh and allowed to dry thoroughly. The thickness of the second layer has been varied from 1-in. to 3-in. according to the surface temperatures on particular sections of the turbine. In the highest temperature zone, the second layer is 3-in. thick to provide a total of 6-in. of mineral wool cement. Note that the bolts have been completely covered to form a smooth, unbroken Btu-barrier.

To reach the bolts for maintenance of the turbine, it is only necessary to chip away the mineral wool cement around the bolts and remove the cloth covers. The nuts are then taken off and the top of the turbine lifted. When maintenance is completed, the turbine top is simply bolted back into place and the bolts re-insulated with a small amount of mineral wool cement. The major portion of the insulation jacket on the turbine remains intact with no damage.

After insulation is completed, a steel housing is installed over the turbine.

Watch Your Overspeed Trip Devices

Two cases related by the Hartford Steam Boiler Inspection and Insurance Company in *The Locomotive* indicate the necessity for vigilance in the care and maintenance of overspeed protection devices on steam turbines and other types of rotating machines

MOST OVERSPEED accidents to steam turbines involve a sudden loss of load followed by failure of the speed controls and the emergency overspeed controls. And, in nearly every case, the controls have failed simply because they have not been tested frequently and "exercised" throughout their full length of travel to keep moving parts free to act quickly and surely. Two recent accidents which followed this pattern are described here. In each case, a sudden loss of load was brought about by an unusual chain of circumstances, and in each case the emergency controls stuck fast when the emergency arose.

Truck Hits Power Pole

One accident involved a 1500-kw steam turbine driving a generator in an industrial plant. The trouble started when a truck backed into a guy wire on a power-line pole outside the plant. The pole was shaken by the blow, causing the power lines to swing together and short circuit. The short caused a voltage drop throughout the electrical system of the plant and, as a result of this drop, about two-thirds of the electrical equipment was shut down by low-voltage relays.

Sudden changes in the turbine load resulted from this series of events. First there was a surge from normal load up to the short-circuit overload, and then, as the short cleared, a drop to about one-third of normal load.

In response to the rapid load changes, the turbine governor should have opened the steam valves wide for the overload, and then closed them down for the drop to subnormal load. The valves did open wide when the short occurred, but they failed to close when it cleared, and the turbine began to overspeed.

The plant lights went out when the short occurred and then came back on very bright. An operator rushed to the turbine room to investigate the trouble and found the turbine, which normally operated at 3,600 rpm, overspeeding at about 4,100 rpm. He tried to bring the unit under control by manipulating the hand wheel on the speed changer, but this had no effect, and the turbine speed continued to increase. He then tripped the throttle valve by hand, but the speed still increased and the machine started to vibrate badly. Unable to control the unit, the operator, fearing an explosion, ran from the room, but in a few seconds, the turbine began to slow down.

When the unit was examined it was found that the stems of the steam control valves had become bound at their packings when they opened wide for the short circuit overload. Evidently the throttle valve had also become bound but was finally closed by the severe vibration of the racing machine. This fortunately averted a serious explosion, but severe damage to the unit had already taken place.

Although there was no particular damage to the steam end, both retaining rings on the generator rotor were stretched. The rotor laminations and the centering ring were distorted, and the bearings of the generator and the exciter were battered. The damage to the unit was valued at $12,000.

Fog Causes Short Circuit

In the second case a short circuit was also involved, but more indirectly. The short in this instance occurred in a substation. Accumulations of dirt on a transformer insulator became wet in a heavy fog and permitted the current to jump across to cause the short circuit. When the short circuit occurred, the plant power supply tripped out and all electrically driven station auxiliaries stopped, including a motor-driven boiler feed pump.

An operator started a standby boiler feed pump driven by a 1000 hp steam turbine. It ran for about 10 minutes and brought the boiler water level up to normal. The boiler feed valves then closed automatically, and the turbine lost most of its load. The turbine was equipped with a single steam control valve which failed to respond to the change in load, and the unit began to overspeed.

Unusual noises coming from the overspeeding turbine attracted the attention of an operator who reached the unit in time to shut it down before an explosion resulted, but the machine had already suffered heavy damage. The turbine shaft was bent; the wheel and blades were loosened; all bearings and their housings were broken up. The total damage amounted to nearly $7,000.

Examination of the control valve stem, still in the open position after the accident, showed that it was tightly bound in its packing. The quick-closing valve operated by the emergency governor was broken in the accident, but it was also found in the open position.

Basic Power Plant FIGURING

By WILLIAM H. ENGELMAN
Mechanical Engineer, Cleveland, Ohio

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How to Calculate Piston Pumps—Displacement, Capacity, Slippage

PISTON PUMPS have a positive displacement per stroke and it is therefore comparatively easy to figure the capacities or the volume of liquid delivered. Simple arithmetic only is required for their calculations.

In this article complete calculations will be given and tables for capacities per second, minute, hour and day; also conversion of cubic inches to gallons and cubic feet or vice versa.

CONVERSION TABLE for FLOW OF LIQUIDS in GALLONS PER MINUTE (GPM) to GALLONS and CUBIC FEET PER SECOND, MINUTE, HOUR and 24 HOUR DAY

Gallons Per Min. GPM	GALLONS			CUBIC FEET		
	Second	Hour	24 Hr Day	Second	Minute	Hour **
0.5	0.00833	30	720	0.00111	0.06684	4.0104
1	0.01667	60	1,440	0.00223	0.13368	8.0208
2	0.03333	120	2,880	0.00446	0.26736	16.0417
3	0.05000	180	4,320	0.00668	0.40104	24.0625
4	0.06667	240	5,760	0.00891	0.53472	32.0833
5	0.08333	300	7,200	0.01114	0.66840	40.104
6	0.10000	360	8,640	0.01337	0.80208	48.125
7	0.11667	420	10,080	0.01560	0.93576	56.146
8	0.13333	480	11,520	0.01782	1.06944	64.167
9	0.15000	540	12,960	0.02005	1.20312	72.187
10	0.16667	600	14,400	0.02228	1.3368	80.208
20	0.33333	1,200	28,800	0.04456	2.6736	160.417
30	0.50000	1,800	43,200	0.06684	4.0104	240.625
40	0.66667	2,400	57,600	0.08912	5.3472	320.833
50	0.83333	3,000	72,000	0.11140	6.6840	401.042
60	1.0000	3,600	86,400	0.13368	8.0208	481.25
70	1.1667	4,200	100,800	0.15596	9.3576	561.46
80	1.3333	4,800	115,200	0.17824	10.6944	641.67
90	1.5000	5,400	129,600	0.20052	12.0312	721.88
100	1.6667	6,000	144,000	0.22280	13.3681	802.08
150	2.5000	9,000	216,000	0.3342	20.052	1,203.1
200	3.3333	12,000	288,000	0.4456	26.736	1,604.2
300	5.0000	18,000	432,000	0.6684	40.104	2,406.2
400	6.6667	24,000	576,000	0.8912	53.472	3,208.3
500	8.3333	30,000	720,000	1.1140	66.840	4,010.4
600	10.000	36,000	864,000	1.3368	80.208	4,812.5
700	11.667	42,000	1,008,000	1.5596	93.576	5,614.6
800	13.333	48,000	1,152,000	1.7824	106.944	6,416.7
900	15.000	54,000	1,296,000	2.0052	120.312	7,218.8
1,000	16.667	60,000	1,440,000	2.2280	133.681	8,020.8
1,500	25.000	90,000	2,160,000	3.342	200.52	12,031
2,000	33.333	120,000	2,880,000	4.456	267.36	16,042
3,000	50.000	180,000	4,320,000	6.684	401.04	24,063
4,000	66.667	240,000	5,760,000	8.912	534.72	32,083
5,000	83.333	300,000	7,200,000	11.140	668.40	40,104
6,000	100.00	360,000	8,640,000	13.368	802.1	48,125
7,000	116.67	420,000	10,080,000	15.596	935.8	56,145
8,000	133.33	480,000	11,520,000	17.824	1,069.4	64,167
9,000	150.00	540,000	12,960,000	20.052	1,203.1	72,188
10,000	166.67	600,000	14,400,000	22.280	1,336.8	80,208
20,000	333.33	1,200,000	28,800,000	44.560	2,673.6	160,417
30,000	500.00	1,800,000	43,200,000	66.840	4,010.4	240,625
40,000	666.67	2,400,000	57,600,000	89.120	5,347.2	320,833
50,000	833.33	3,000,000	72,000,000	111.400	6,684.0	401,041
60,000	1000.00	3,600,000	86,400,000	133.681	8,020.8	481,250

** Cu ft per hr × 24 = cu ft per day.

Piston pump dimensions are always given in inches. In the case of a steam-driven piston pump the dimensions are stated as follows: 8 in. by 6 in. by 10 in.

Where: 8 in. is diameter of the steam piston.
6 in. is diameter of the water piston.
10 in. is the stroke.

In calculating pump capacities, the following steps in the order given should be observed:

1. Find area of piston in square inches; $d \times d \times 0.7854$; use tables.
2. Find volume per stroke in cubic inches; area × stroke is displacement and not the actual discharge; the slippage must be considered.
3. The volume per stroke × number of strokes per minute gives the displacement in cubic inches per minute.
4. Cubic inches per minute ÷231 is displacement in gallons per minute (gpm).

Problem 1:

An 8 in. by 6 in. by 10 in. pump makes 25 strokes per minute. What is the displacement in gpm?

1. Area of piston is 6×6×0.7854 or 28.2744 sq in. See table.
2. Volume per stroke is 28.2744×10 or 282.744 cu in. (displacement).
3. Volume per minute is 282.744×25 or 7,068.6 cu in.
4. Displacement is 7,068.6÷231 or 30.6 gpm.

Items 1 to 4 combined:

$$\frac{6 \times 6 \times 0.7854 \times 10 \times 25}{231} = 30.6 \text{ gpm displacement.}$$

There are 231 cu in. in a gallon and 1,728 cu in. in a cubic foot.

One gallon is 0.1337 cu ft and 1 cubic foot is 7.48 gal.

Conversion table applications page 80

Note that there is a variation in the weight of a gallon of water corresponding to the changes of temperature of the water. This must be taken into account in all pumping problems. The weights of water at various temperatures may be found in the Steam Tables, where they are given as cubic feet per pound. Or they may be found from this formula

Gpm =
lb per hr ÷ (500 × Specific Gravity)

The specific gravity of water at various temperatures is shown in the attached curves, taken from How to Select Centrifugal Boiler Feed Pumps by I. J. Karassik, POWER ENGINEERING, September, 1950. (Curves on page 80)

The actual discharge of a piston pump is always less than the dis-

placement; this is known as slippage and is expressed in per cent of the displacement. It is the difference between the displacement and the actual discharge.

Displacement = Actual Discharge + Slippage

The volumetric efficiency of a piston pump is the ratio of the liquid actually discharged and the displacement. Pump slippage varies from about 1 per cent in pumping engines to as much as 30 per cent in smaller units. For pumps in good operating condition, the slippage runs from 3 to about 10 per cent.

Manufacturers' catalogs give the rated capacity of pumps in piston displacement; therefore an estimated reduction from these values must be made to cover leakage or slip, in order to get the actual discharge.

Due to the reciprocating motion of the piston pump, strains and wear on all working parts are severe and this limits the number of strokes per minute. Experience has shown that for continuous service a fair value for the number of strokes per minute is about 25 for large pumps and up to 50 for smaller pumps. For intermittent service these values may be increased by 50 per cent.

Problem 2:

What would be the discharge in the previous example if the slippage is 5 per cent?
Discharge per stroke is $282.744 \times (1.00 - 0.05) = 268.607$ cu in.
Discharge in gallons is $30.6 \times (1.00 - 0.05) = 29.07$ gpm.

Problem 3:

What is the discharge in gpm of a 6 in. by 4 in. by 8 in. pump making 30 strokes per minute and a slippage of 7 per cent?
The discharge is

$$\frac{4 \times 4 \times 0.7854 \times 8 \times 30\ (1.00 - 0.07)}{231} = 12.14 \text{ gpm.}$$

Problem 4:

A 12 in. by 10 in. by 15 in. piston pump discharges 21.80 cu ft of water per minute when making 35 discharge strokes per minute.

Calculate:

a. the displacement in cubic feet.
b. the slippage in cubic feet.
c. the slippage in per cent.
d. the volumetric efficiency.

Solution:

a. $\frac{10 \times 10 \times 0.7854 \times 15 \times 35}{12 \times 12 \times 12} =$ 23.862 cu ft displacement.
b. $23.862 - 21.80 = 2.062$ cu ft, the slippage.
c. $2.062 \div 23.862 =$ 0.0864 or 8.64 per cent slippage.
d. $21.80 \div 23.862 =$ 0.9136 or 91.36 per cent volumetric efficiency.

Problem 5:

A piston pump has a displacement of 696.2 gal when making 200 strokes. The diameter of the piston is one-half of the stroke or 2 diameters equal the stroke. Find piston diameter and stroke.

Solution:

Displacement per stroke is $696.2 \div 200 =$ 3.481 gal.
Piston displacement is $d \times d \times 0.7854 \times 2d =$ $1.5708\ d^3$
Therefore: $3.481 \times 231 = 1.5708\ d^3$

and: $d^3 = \frac{3.481 \times 231}{1.5708} = 512$

Solving: $d = \sqrt[3]{512} = 8$ in. diameter piston.
The stroke is 2d or $2 \times 8 = 16$ in.

Problem 6:

A pump discharges 925 gal of water with a slippage of 7.5 per cent when making 200 strokes. The stroke is 1.8 times piston diameter.

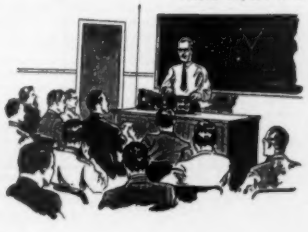
Calculate:

a. the displacement in gallons.
b. the slippage in gallons.
c. the volumetric efficiency.
d. diameter of piston in inches.
e. length of stroke in inches.

Actual discharge is..... 92.5% or 925 gal
Slippage is..... 7.5% or 75 gal
Displacement is.....100.0% or 1000 gal

Solution:

a. Displacement is $925 \div (1.00 - 0.075) =$ 1000 gal.
b. Slippage is $100 - 925 = 75$ gal.
c. Vol. efficiency is $925 \div 1000 =$ 0.925 or 92.5 per cent.
d. $1000 \div 200 = 5$ gal per stroke or 1155 cu in.
$d \times d \times 0.7854 \times 1.8\ d =$ $1.41372\ d^3$ which equals 1155
$d^3 = 1155 \div 1.41372 = 817$
$d = \sqrt{817} = 9.3485$ in.; use 9⅜ in. diameter piston.
e. Stroke is $1.8\ d = 9.3485 \times 1.8 =$ 16.827 in., use 17 in.



CONVERSION TABLE for FLOW OF WATER IN MILLION GAL PER DAY (MGD) to GALLONS and CUBIC FEET PER HOUR, MINUTE AND SECOND

Million gal/day (MGD)	GALLONS			CUBIC FEET		
	Hour	Minute	Second	Hour	Minute	Second
0.025	1,041.67	17.36	0.2893	139.25	2.321	0.03868
0.050	2,083.33	34.72	0.5787	278.50	4.642	0.07736
0.075	3,125.00	52.08	0.8680	417.75	6.962	0.11604
0.10	4,166.67	69.44	1.1574	557.00	9.283	0.15472
0.15	6,250.00	104.17	1.7361	835.50	13.925	0.23208
0.20	8,333	138.89	2.3148	1,114.0	18.567	0.30945
0.25	10,417	173.61	2.8935	1,392.5	23.208	0.38681
0.30	12,500	208.33	3.4722	1,671.0	27.850	0.46417
0.35	14,583	243.05	4.0509	1,949.5	32.492	0.54153
0.40	16,667	277.77	4.6296	2,228.0	37.133	0.61889
0.45	18,750	312.50	5.2083	2,506.5	41.775	0.6963
0.50	20,833	347.22	5.7870	2,785.0	46.417	0.7736
0.55	22,917	381.94	6.3657	3,063.5	51.058	0.8510
0.60	25,000	416.67	6.9444	3,342.0	55.700	0.9283
0.65	27,083	451.39	7.5231	3,620.5	60.342	1.0057
0.70	29,167	486.11	8.102	3,899.0	64.984	1.0831
0.75	31,250	520.83	8.680	4,177.5	69.625	1.1604
0.80	33,333	555.55	9.259	4,456.0	74.267	1.2378
0.85	35,417	590.28	9.838	4,734.5	78.909	1.3151
0.90	37,500	625.00	10.417	5,013.0	83.550	1.3925
1	41,667	694.4	11.574	5,570	92.83	1.5472
2	83,333	1,388.9	23.148	11,140	185.67	3.0945
3	125,000	2,083.3	34.722	16,710	278.50	4.6417
4	166,667	2,777.8	46.296	22,280	371.33	6.1889
5	208,333	3,472.2	57.870	27,850	464.17	7.7361
6	250,000	4,166.7	69.444	33,420	557.00	9.283
7	291,667	4,861.1	81.018	38,990	649.84	10.831
8	333,333	5,555.5	92.592	44,560	742.67	12.378
9	375,000	6,250.0	104.167	50,130	835.50	13.925
10	416,667	6,944.4	115.741	55,700	928.34	15.472
15	625,000	10,416.7	173.61	83,550	1,392.5	23.208
20	833,333	13,888.9	231.48	111,400	1,856.7	30.945
25	1,041,667	17,361.1	289.35	139,251	2,320.8	38.681
30	1,250,000	20,833.3	347.22	167,101	2,785.0	46.417
35	1,458,333	24,305.5	405.09	194,951	3,249.2	54.153
40	1,666,667	27,777.8	462.96	222,801	3,713.3	61.889
45	1,875,000	31,250.0	520.83	250,651	4,177.5	69.625
50	2,083,333	34,722.2	578.70	278,501	4,641.7	77.361
55	2,291,667	38,194.4	636.57	306,351	5,105.8	85.098
60	2,500,000	41,666.7	694.44	334,201	5,570.0	92.834
65	2,708,333	45,138.9	752.32	362,052	6,034.2	100.57
70	2,916,667	48,611.1	810.19	389,902	6,498.4	108.31
80	3,333,333	55,555.5	925.93	445,602	7,426.7	123.78
90	3,750,000	62,500.0	1,041.67	501,302	8,355.0	139.25
100	4,166,667	69,444.4	1,157.41	557,002	9,283.4	154.72

THE MYSTERY OF THE OPEN DOORS

A Tale of Tails

By H. B. McDERMID

IN A LARGE WAR PLANT, equipped with every ultra-modern device, most of the large doors were supplied with self opening devices, set in motion by the familiar *breaking of the ray* photoelectric method by the entering vehicle or person.

One such opening in one of the buildings was designed to pass any size truck built, at any speed, without a thought by the driver of any clearances: it had two leaves, probably weighing a ton each, both controlled by the *ray* as above noted.

It was cold mid-winter, and the electrical maintenance man in charge of the door moving mechanism was seriously worried; these big doors were often found open, suggesting that the closing mechanism had gone bad. By the time some nearby worker had left his regular job and closed them, the room usually was decidedly cooler, and the complaints were piling up at a rapid rate. The maintenance man had checked and tested the mechanism over and over; could find nothing wrong anywhere, except that the doors were undeniably left open when they should be closed. He had visions of his boss telling him to get off the job and give some one with brains and skill enough a chance to handle it properly.

Like most big jobs, the place had a small army of half-wild alley cats around, attracted by the heated buildings and the food scraps they could pick up. Our man wondered if they could have anything to do with his problem, but instantly dismissed the idea in view of the facts that there were no cats tall enough to *break the ray* in any ordinary manner; they could easily walk through the doorway, without in any way disturbing the control mechanism.

One day, as he stood viewing the doors and wondering what next, they opened, but instead of the expected vehicle, there stood an ordinary alley cat on the sill, looking the shop over, before venturing in. As the maintenance man went to close the doors, the cat came in, but being at his wits end, our man decided to do some detective work, with the cat as his main object. After quite a watch, his patience was rewarded; the cat started for the closed doors. He noted that kitty's back came far under the ray, as it approached the doorway; but just at the proper spot something happened — the cat flipped its tail to a vertical position, *broke the ray*, the great doors swung open and the cat sauntered out as nonchalantly as if the whole world had been created expressly for him, just as he had ordered it. He did not break the second ray, and so close the door, but opening them obviously was old stuff to him.

(*Basic Power Plant Figuring, Continued From page 79*)

PRACTICAL APPLICATION OF THE CONVERSION TABLE

1. The demand on a pump is 375 gpm
What is it expressed in the other units?

	GALLONS			CUBIC FEET		
Demand 375 GPM	Second	Hour	GPD	Second	Minute	Hour
300	5.0000	18,000	432,000	0.66840	40.1040	2406.20
70	1.1667	4,200	100,800	0.15596	9.3576	561.46
5	0.0833	300	7,200	0.01114	0.6684	40.104
375	6.2500	22,500	540,000	0.83550	50.1300	3007.764

This requires only addition of values given in the table.

2. A pump delivers 7.5 mgd
What is it in the other units?

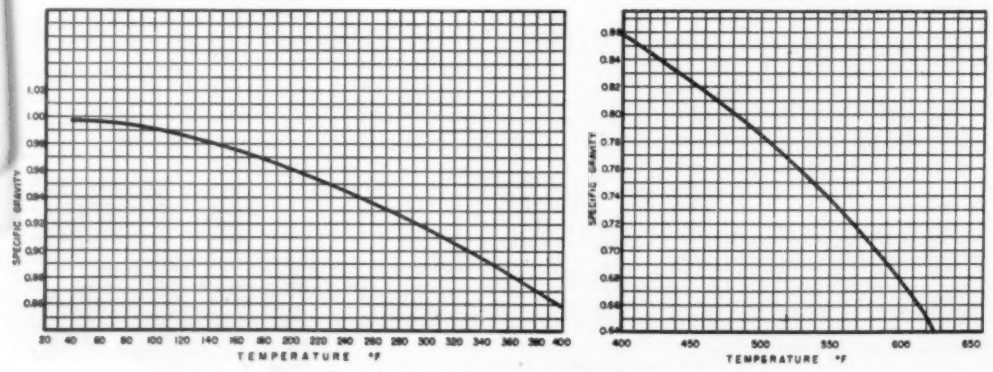
	GALLONS			CUBIC FEET		
Demand 7.5 MGD	Hour	Minute	Second	Hour	Minute	Second
7.0	291,667	4,861.1	81.018	38,990	649.84	10.831
0.5	20,833	347.2	5.787	2,785	46.42	0.774
7.5	312,500	5,208.3	86.805	41,775	696.26	11.605

These values could have been obtained from the conversion table under 0.75 mgd by moving the decimal one figure to the right.

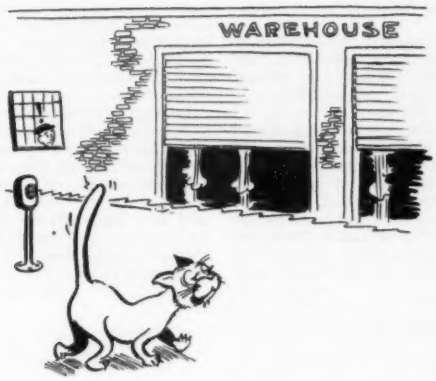
Let the rate of pumpage be 1,000,000 gal per day (or 1 mgd)
Then: 1,000,000 ÷ 24 = 41,666.67 gph
1,000,000 ÷ (24 x 60) = 694.4444 gpm
1,000,000 ÷ (24 x 60 x 60) = 11.574074 gps

If 1 mgd is to be expressed in cu ft
Then: 1,000,000 ÷ 0.13368055 = 133,680.55 cu ft per day
133,680.55 ÷ 24 = 5.570.023 cu ft per hr
133,680.55 ÷ (24 x 60) = 92.83372 cu ft per min
133,680.55 ÷ (24 x 60 x 60) = 1.547229 cu ft per sec

1 gallon = 231 ÷ 1728 = 0.133680555 cu ft
1 cu ft = 1728 ÷ 231 = 7.48052 gal



Specific gravity of water for various temperatures (I. J. Karassik)



Afterward, the trick was observed repeatedly, and the fact that the cats were the responsible parties was fully established. One old mammy cat would sometimes perform on request and that, to one who knows the stubborn nature of the beasts, seems almost as remarkable as the performance itself. If gently set down and pointed towards the door, pussy would sometimes saunter 100 ft to the ray, there, at exactly the right instant, flip her tail straight up, break the ray and open the doors as serenely as if she had designed and built them for that very purpose.

But how in this world did the first cat learn the trick? It looks as if the fellow badly missed the boat when he included half-wild alley cats as being among the *dumb* animals.

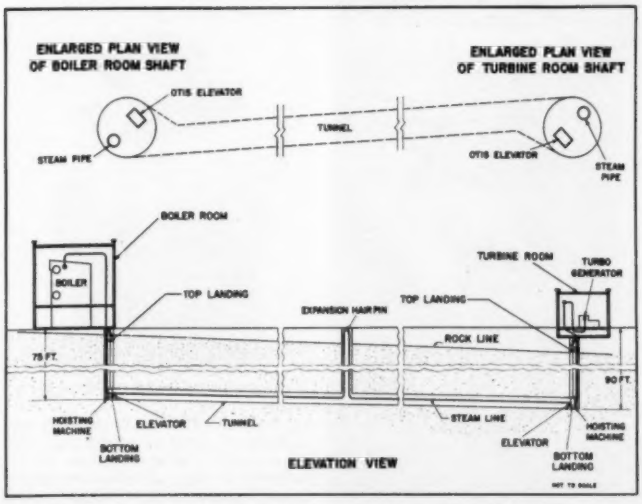
Editor's Note: Mr. McDermid assures us that this story is true. After the maintenance man discovered the cause of his door troubles, to verify the tale he picked up an old mammy cat that was around, and pointed her for the giant door, as large as any he had ever seen and a good hundred feet away. After gently urging her to start, she performed as if she had been trained, flipped her tail at exactly the right instant, broke the ray, and as the doors rolled open, walked lazily out. Mac says he verified the story through plenty of witnesses, and had the Company's house organ print it after the editors had verified it fully.

Small Electric Elevators Serve Underground Steam Line

Boiler plant at the Argo Corn Products plant, located 1300 feet away from existing turbine room, makes necessary unusual piping installation. Steam line 75 to 90 ft below ground installed in a 10-ft tunnel, served by elevators at both ends

FREQUENCY of inspection and maintenance operations on a new high-pressure underground steam line at the Argo, Illinois plant of the Corn Products Refining Company recently dictated the installation of two small Otis elevators as the most economical means for carrying workers and equipment down to lower tunnel levels.

These elevators — located at opposite ends of a 1300-ft tunnel between a new boiler room and an existing turbine room — transport men and materials 75 ft and 90 ft below basement levels many times daily, see illustration. In addition to being used for maintenance and inspection operations, the tunnel serves as an all-weather passageway for power-station personnel.



Two small Otis elevators, one under the boiler room and one under the turbine room at the Corn Products Refining Co., Argo, Illinois, carry maintenance personnel, tools, and materials down to a high-pressure underground steam line in the 1300-ft tunnel connecting these two buildings

The idea for this tunnel was part of an overall plan by Corn Products' consulting engineers, Sargent and Lundy of Chicago, to expand the power-generating capacity of the plant from 12,000 to 22,500 kw.

The problem was to locate the new boiler room on a site: where it would not expose the food-processing plant to smoke from coal-fired boilers; that would provide room for further expansion; and to which the steam could be economically conveyed.

If the new boiler room were located at the far northern edge of the property, the first two problems would be solved. However, the success of this plan depended upon finding a means for conveying steam efficiently from boilers to turbines at temperatures up to 750 F and pressures up to 650 psi.

An initial plan to lay a shallow steam line around the plant was considered impractical because of the interference of existing structures and railroad tracks. It was finally decided to construct a straight-line tunnel between the boiler and turbine buildings, even though this meant burying the steam line far underground so that it would pass below existing utilities.

This tunnel, which has a 10-ft internal diameter, encases an 18-in. mineral-wool insulated steam pipe. Provisions were made for the installation of a second pipe when this becomes necessary. Frequent inspection and repair operations are necessary on this pipe line because daily

temperature changes from 50 to 750 F cause a 54-in. expansion in the line.

To provide for the frequent vertical transportation of personnel, tools, and materials from upper levels to the underground steam pipe, a small automatic passenger elevator was installed at each end of the tunnel. The space occupied by the steam pipe and its access ladder, in addition to the space reserved for a future second pipe, left room in the 10-ft diameter vertical shafts for only the smallest-size cars.

The 1200-lb capacity Otis elevators installed here have a platform size of 3 by 3¼ ft. Their 4¼-hp geared motors (460 v at 60 cycles) drive them at a speed of 100 fpm.

Top-level landings for each elevator are 15 ft below ground level, and their hoistway machinery had to be fitted into a headroom of only 14 ft, 6 in., also below ground. This arrangement was necessary because the space directly over the boiler-house hoistway is occupied by coal feeders and pulverizers and the space over the engine-house is occupied by turbine equipment. Workmen walk down stairways from the basement level of each building to top elevator landings. Bottom elevator landings are platforms 3 ft 10 in. above the tunnel floor.

Shortly after installation it was found that use of the elevators by operating personnel going from one section to another did not interfere with the activities of maintenance personnel. For this reason, the tunnel now finds daily use serving both the maintenance function and as an all-weather passageway between power-station buildings.

PRACTICAL HINTS AND KINKS

HEATER SPEEDS SCREENING OF MOIST MATERIALS

Simple method of electrically heating wire screens prevents clogging of mesh by moist materials when being screened

ORIGINALLY developed to facilitate screening of moist clay used in brick and tile manufacture, a simple electric screen heater is finding increasing use in industry for speeding up screening of sand, coal, lime, ores, chemicals and other materials which contain moisture and are not readily inflammable or explosive and are non-conductors.

Applicable to woven wire screen, No. 2 mesh or smaller, the heater made by F. R. Hannon & Sons is inexpensive to operate and will perform successfully on either new or old gravity or vibrating type installations. It consists of a specially-designed, high-efficiency step-down transformer which converts 220, 440 or 550-volt alternating current to low-voltage heating current. The low-voltage current is then delivered through high-amperage cables to special bus bars which extend the full length of the screen on each side.

The screen acts as resistance to flow of the low-voltage current and is heated just enough to reduce the moisture content of the material as it passes over the mesh. As a result the material passes more readily through the mesh and "blinding", caused by moist material filling or bridging the openings, is eliminated.

Depending on the nature and moisture content of the material being screened, screen capacity is increased as much as 50 per cent and, "beating" to keep the screen open is no longer required. This results in a direct labor saving as well as greatly-increased screen life.

The transformer is rugged and fool-proof and installation can be made by any competent plant electrician from instructions furnished. Voltage and temperatures developed are such as to present no hazard from fire or electrical shock.

Fig. 1. Unheated screen used in screening clay after several minutes operation. Note total blinding of mesh

Fig. 2. Screen heated by Hannon Electric Screen Heater after one hour operation on same clay. Note complete absence of blinding

MERCURY SWITCHES FOR LIQUID LEVEL CONTROL

ONE OF THE most successful and practical applications of industrial mercury switches has been in the field of liquid level controls, according to E. C. White, in charge of mercury switch sales for the General Electric Company's Industrial and Transmitting Tube Division.

Mercury switch installed on Magnetrol

Proof of their effectiveness comes from Magnetrol, Inc. of Chicago who have been using G-E mercury switches for their "Magnetrols" for many years. They recently intro-

duced a new control Model 26, employing a new G-E switch (Type 4-2KRI). This new control not only cuts off the burner of a steam boiler when the water reaches a dangerously low level but also notifies the boiler operator by a buzzer or warning light that the fuel supply has been cut off.

The new switch, to accomplish this, is the single pole, double-throw type. The heavy contacts which cut the burner off when the water is low are mercury to mercury. The advantage of the mercury to mercury contact is that there are no fixed metal points to wear away. Here the switch will handle up to 15 amps.

TROUBLE WITH MOTOR THRUST BEARING

THIS TYPE OF trouble is not uncommon where bearings are subjected to extreme cold. On starting, lubrication is practically non-existent due to the thickening of the oil. Under these conditions severe wear occurs.

This is remedied as the machine warms up, but it is found that running with congealed oil even if only for a short time causes severe wear.

Using a thinner oil provides no remedy. The only real solution is to change to an oil which is an effective lubricant at low temperatures, such as oils used for high-altitude aircraft. Contributory causes may be slight misalignment endways which causes a downward movement on the thrust. Also the heat transmission through the bearing may be bad with the result that heat is not conducted away freely.

GAS SHRIEK IN BURNER LINES REDUCED BY MINERAL WOOL INSULATION

MINERAL WOOL felt insulation on gas lines feeding burners at the Long Island Lighting Co., Glenwood Landing power station, has considerably improved personnel comfort and efficiency by reducing the piercing shriek of fast-flowing natural gas to a soft murmur inaudible above normal plant noises. Although mineral wool's primary job at the 170,000-kw plant is to cut heat loss from high-temperature equipment, reduction of noise level in working areas adjacent to the burners is the only function of insulation on the overhead gas lines.

In the photograph, the T-shaped pipe section above the burners of Glenwood's boiler No. 4 supplies incoming natural gas at a temperature of about 30 F. Four small pipe sections connect the large horizontal gas line to the burners.

The insulations applied on the T-shaped pipe section were a single layer of 1½-in.-thick mineral wool felts, in 24 by 48-in. units, and two ½-in.-thick layers of insulating cement. The felts were wrapped around the gas line and tightly secured with 20-gage wires circling the insulation on 8-in. centers. A layer of 1-in. wire mesh was wired over the felts and the two coats of insulating cement were trowelled on. The first coat was allowed to dry thoroughly before the second was applied. A coat of asphalt mastic was trowelled over the insulating cement, glue-sized and finished with two coats of aluminum paint.

UNIT HEATER FAILURES

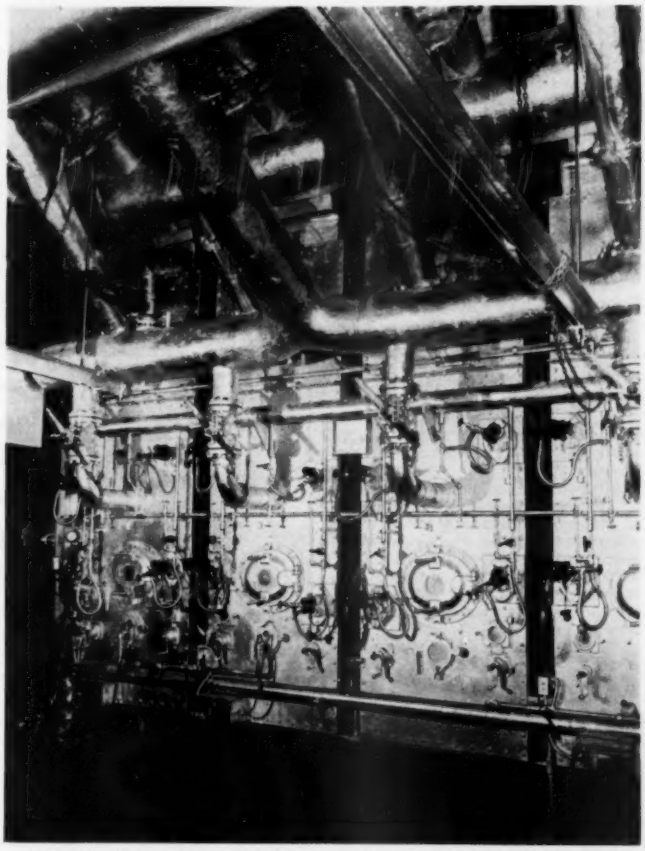
By CLOYD J. RAY

IN OUR PLANTS, we experienced considerable trouble with unit heaters developing leaks and, while the confession comes hard, we were some time discovering the cause of the failures.

We operate the heaters at 100 psi and were told by numerous advisers that if we would reduce the pressure to 50 psi or less, our trouble would cease. However, yours truly noted the units were designed for 150 psi and just could not swallow the idea of reducing the pressure as a remedy. Further investigation and inquiry revealed the fact that operators of heaters on medium and even low pressures were also experiencing trouble in the same way.

Smiles on the faces of the wise are visualized, no doubt saying, "Why sure, we knew that!" as we relate the simple cure. There are times when we all fail to apply simple principles even though we do know them.

The cause of the trouble was inadequate drainage. While we have a regular trap inspection and repair routine, it was discovered that partial plugging of the trap openings by welding slag, thread cuttings, scale, or matter released in the lines by wear, was found in connection with the failures. Now, of course, we are wised up and fully realize the importance of drainage. We now have a stepped-up inspection of the traps and have replaced, changed types, changed to larger sizes where necessary and inserted strainers ahead of the traps. No heater failures have occurred since.



Front of No. 4 boiler at Glenwood Landing plant showing gas lines insulated with mineral wool

Questions and Answers

Q & A—THE POWER ENGINEER'S FORUM—

HERE'S HOW IT WORKS

YOUR QUESTION about some problem in operation, maintenance or design will be published, signed only with your initials.

Answers to your questions from other readers will be sent you as soon as received, then published as space permits, so that all may have the information.

You, too, answer questions from other engineers in the same way. You get paid well for published answers and also get the credit for knowing them.

If other engineers help you solve your problem, you express your thanks, via the Q & A editor.

Simple, isn't it? And effective! Just ask engineers who have tried it!

Question No. 488

WHY USE STEAM TO OPERATE TURBINES?

WHY ISN'T IT possible and practical to use high-pressure compressed air or high-pressure cold water, as well as high-pressure steam, to operate steam turbines?

Wouldn't that provide cooler operation in the hot summer time, also in warm locations?

What difference does it make what is used, so long as it can make the turbine shaft turn over?

Massachusetts S. J. W.
(Industrial Plant Electrician)

Editor's Note:—Well, go ahead, tell him!—and prove it without integral calculus, either! Have we been taking too much for granted since Newcomen, Watt and Stodola?

Question No. 489

HOW CAN HE MEET SHORT PEAK STEAM DEMAND?

ON ONE of our installations, we furnish steam for a rather large laundry and dry-cleaning plant. This steam is generated with two 100-hp hrt boilers, oil-fired, maximum steam pressure 100 psig.

After making some changes in the oil burners and drafts, and utilizing all waste heat available from some internal combustion engines, we have been able to cut out one of the boilers for all but one half-hour after the laundry starts up in the morning and again on starting up after the noon hour.

At that time the load is a little more than one boiler can handle. The steam pressure will be pulled down and the single boiler cannot get it back up without help from the other boiler. But once that short heavy demand for steam is over, one boiler will handle the load all the rest of the time.

The second boiler must be kept hot just for those two short periods of the day, which results in a waste of fuel.

There are no steam flow meters on any of the steam feeder lines and we have no control over the use of the steam. So we cannot schedule the load to iron out these peaks. But we would like to get away from firing up that second boiler if possible.

Can some Q & A reader give us some help with this problem? We have thought about trying an accumulator, but as we have never had any experience with one nor have been able to talk with anyone who has, we are not sure that an accumulator would give us volume enough. If anyone thinks an accumulator will help us, will they please give us information on its installation and operation. Or is there anything else we can do?

Puerto Rico W. O. T.

"I tell you, it will revolutionize steam power generation!"

Answer No. 485

CAN VERTICAL STEAM ENGINES RUN WITHOUT CYLINDER LUBRICATION?

Only When Steam Was Wet, says Tatman

YES, SOME TYPES of small vertical marine steam engines have run without cylinder oil. This was known as water lubrication, but was only practiced on small up-and-down jobs where the condensate had to be used for boiler feedwater. This was in the days when steam pressure was low and steam very wet. To oil lubricate this type of job would have called for a compounded oil of about 8 per cent fatty oils, which had a tendency to emulsify. In those days they did not have the equipment or know-how to de-oil this water, so took the lesser of

the two evils, that of high piston ring and cylinder wear, over that of burnt boilers.

I doubt very much if any engines of this type are in service any more, for the internal combustion engine has largely replaced all the small steam marine engines.

With our modern large steam engines, vertical or otherwise, operating with high-pressure superheated steam, I think Ambitious Al will find that lubricating the cylinders with oil and then de-oiling the condensate, if it is to be used again, will be more practical and less expensive than replacing worn piston rings and engine cylinders caused by a dry piston traveling up and down in a dry cylinder, with the subsequent power loss.

Perhaps he has a picture in his mind's eye of the piston in a vertical engine cylinder moving up and down almost frictionally free, the piston being supported by the piston rod and not the cylinder wall.

But what he did not see in this picture was the steam pressure forcing the piston rings against the cylinder wall by the build-up of pressure behind the piston ring in the ring groove. The pressure behind the ring, forcing it against the cylinder wall, is about the same as the pressure exerted on the piston head for the first ring, but drops progressively for all the other rings, depending on the piston ring's fit.

Puerto Rico. W. O. TATMAN

Yes, Under Certain Conditions, says Galloway

THE OLD QUESTION as to whether a vertical steam engine can be operated without internal lubrication has come up again. The answer is yes, under certain conditions. The writer has operated several marine jobs and knew of others. Incidentally, the old time marine chief was inclined to some exaggeration on this matter, but it was true that, if oil was injected at all, it was used sparingly.

A vertical marine engine at about 100 rpm, supplied by Scotch boilers at 175 psi, could be weaned away from cylinder oil in about six months if care was used. When new, oil was always required but finally the wet steam would take over the job and the oil could be gradually diminished to zero feed. Good practice called for some injection before a shut-down of an extended period. Even the so-called oil-free jobs did get a trace, through the periodical swabbing of the rods with cylinder oil, but this small amount never caused trouble.

The writer has seen piston rings and cylinder walls polished to a beautiful mirror-like surface after years of operation without oil. For reasons unknown there were some engines which could never be broken of the need of oil and would start grunting after several hours, thereby calling for a squirt or two. Naturally the entire arrangement for skimping on the use of oil was not because of the cost in the can, but the cost of the oil in the boiler, which could even result in the loss of the ship.

Auxiliaries on these ships were seldom equipped with cylinder oil lubricators. Wet steam did the lubricating; for when a pump had to be operated on air, as in a dry-dock, cylinder oil always had to be injected.

The questioner poses the problem of the economics of installing oil-free engines against the cost of oil-removing equipment. Generally speaking, the writer's vote would be to install the filters. Wet steam is a thing of the past. Overall efficiency is more important than the efficiency of an individual unit. The cost of good oil-removing equipment should not bulk very large.

Some thought might be given to reducing the amount of cylinder oil used. When the writer started stationary work, he was astounded at the amount of cylinder oil generally used. He is still convinced that the ordinary plant could get along on one-half the steam cylinder oil it considers necessary.

ROY V. GALLOWAY
Staten Island, N. Y.

WILLIAM H. ENGELMAN

WILLIAM H. ENGELMAN, author of the now famous Basic Power Plant Figuring series that has been running for two years and a half in POWER ENGINEERING and that won the Certificate of Merit in the 1950 Editorial Contest, conducted by *Industrial Marketing*, announces that as of July 1 he has retired from his duties with the Department of Water & Light of the City of Cleveland.

He has joined the Mechanical Engineering Division of H. K. Ferguson Co., Cleveland 14, Ohio, as Mechanical Engineer.

He plans to continue his Basic Power Plant Figuring series in POWER ENGINEERING and is also at work compiling the material into book form for early publication. In addition, he will continue to conduct some classes in the Cleveland School of Steam Engineering for which he originally prepared the Basic Power Plant Figuring material.

PIPE WELDING CLAMP

By THOMAS TRAIL

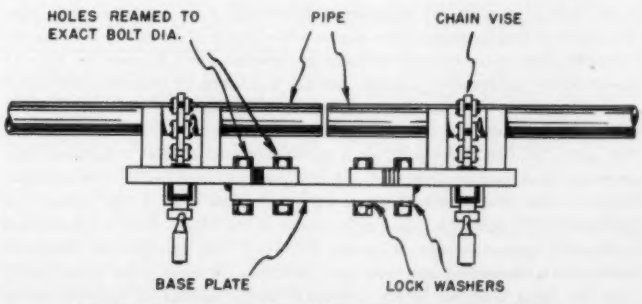
PORTABLE CLAMP for holding pipe ends in alignment for butt welding can be readily constructed, using two chain type pipe vises and a suitable length of flat steel for a base plate, as shown. This clamp can be set up quickly and it can be readily slackened and rotated to different positions to permit welding the entire circumference of the joint.

SCREW STARTERS FOR TOUGH SPOTS

THE PROBLEM of starting screws in hard-to-get-at places is now greatly simplified by the new slot-head screw starters shown here. Every mechanic has experienced the problem of having screws fall into places where they could not be readily retrieved. This new tool provides a patented gripping head which holds the screw firmly for starting. The screw is readily released by merely turning the handle.

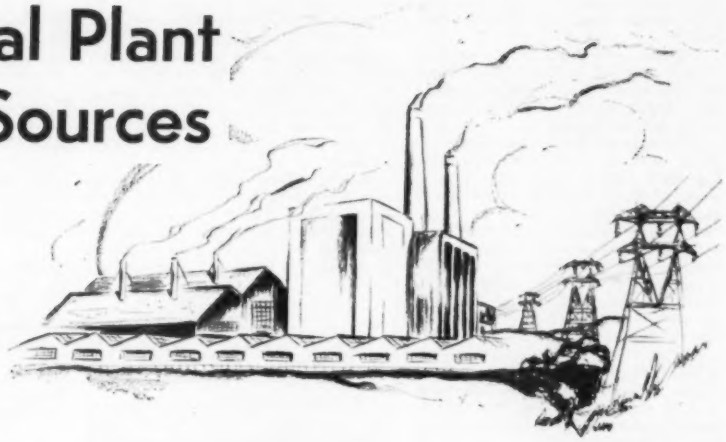
Available with metal handles in 4 lengths — 2½ in., 5 in., 9 in. and 15 in. Also available with nylon handles 6 in. and 9 in. overall in length.

Nylon handle and all-metal screw starters



Portable clamp for holding pipe ends for butt welding, as suggested by Trail

Industrial Plant Power Sources



By RALPH T. WOODRUFF
Chief Electrical Engineer
Aluminum Ore Company,
St. Louis, Mo.

ONE OF THE significant trends in power development in the United States has been the increasing use by industry of central station power. In the early days of industrial development, power was generated exclusively in power plants owned and operated by the industries themselves. With the development of electric lighting in the last few years of the last century, however, central power stations came into being and from that time on more and more industrial plants have purchased their power from such central stations. Until quite recently, however, a considerable amount of power was still generated in privately owned industrial plants. During the last 10 or 15 years, however, the trend towards the use of central station power has been increasing even more rapidly than it did in previous years.

According to one source, industry generated 40 per cent of its power requirements in 1939, only 33 per cent in 1948 and it was estimated that the figure will drop to 30 per cent by 1955. A more recent figure, however, quoted by another source, and based on the census data of 1947, indicates that industrial plants were then generating only 17 per cent of their power requirements. Still another analysis based on the figures of the Federal Power Commission early this year indicated that only 15 per cent of the total power requirements were being supplied by privately owned industrial power plants. So it is quite evident, regardless of the wide variation in these estimates, that there is a definite trend towards the use of purchased power.

This whole question of industrial plant power sources was discussed very ably by Ralph T. Woodruff in a recent paper presented at the meeting of the American Institute of Electrical Engineers in Toronto. In this paper Mr. Woodruff stated that, generally, wherever adequate amounts of purchased power are available at reasonable rates, purchased power will almost certainly be the most economical source unless there are special features of industrial plant requirements involved.

Plants Needing Heat in Processes

Some of these special features, he listed as follows: 1 — Heat needed in processes; 2 — Heat available from processes; 3 — Very large power demands for the processes.

Many types of industrial plants require heat in various types of process work. Such plants include chemical plants, paper mills, oil refineries, food processing plants, etc. It can be said almost axiomatically that where steam at relatively low temperature and pressure is needed in a process, as in chemical plants or paper plants, the power required can be generated at very low cost in topping units from steam produced at higher temperature and pressures than is needed for the process.

Initial steam pressures have gone as high as 1250 psi and initial temperatures have gone as high as 900 F in industrial plants. Depending upon fuel and other costs, the actual out-of-pocket cost of the power thus generated may be as low as 2 mills per kwh or even less in the most favorable cases.

Perhaps the most outstanding example of a power plant of this type is the South Power House of the Dow Chemical Co. at Midland, Michigan. Details of this plant were described in the September 1950 issue of POWER ENGINEERING. In size and design this power plant compares favorably with the latest public utility plants. Two 400,000 lb per hr steam generators and one 30,000 kw turbine generator form the initial unit which was placed in full operation on June 21, 1950.

Aside from the size of the boilers and turbine generator, and the high operating steam pressure of 1250 psi, there are several novel features involved in the design of this plant which deserve mention. One of these features is the use of the cyclone furnace and the other is the unusual feature of a completely pressurized furnace. Another feature of this plant not usually found in industrial power plants is the use of hydrogen cooling for the electric generating unit.

As a matter of fact, this 30,000 kw turbine generator is the largest double-extraction unit ever built. At this plant steam is bled from the turbine

(Continued on page 112)

In the light of present-day engineering knowledge there should be little controversy over the question of the most suitable source of power for a particular industrial plant. In years past, personal preferences often dictated the type of power source but today it is almost entirely a question of economics. All that is needed in making a decision is an intelligent attitude coupled with accurate data concerning fuel costs and availability, heat balance requirements, reliability, etc. The correct solution of the problem is not always simple; often it demands considerable study and analysis, and such analysis sometimes results in unique solutions as in the case of the Aluminum Company plant cited in this article. This article by Mr. Woodruff is based on his paper on this subject which was presented at the AIEE Summer Meeting at Toronto, Ontario in June. Examples Mr. Woodruff presents are outstanding and they serve admirably in showing the varied conditions that have to be met in the selection of power sources for industrial plants

Public Utility Anti-Strike Laws Declared Invalid

By ALBERT WOODRUFF GRAY

Most states have adopted collective bargaining as the procedure to be followed in the settlement of labor-management disputes. Some people, however, have always believed that public utilities are separate from ordinary industry and many states have laws making it illegal for employees of public utilities to strike or for public utility employers to engage in a lock-out. These laws usually provide for an attempt at conciliation, but if this fails, compulsory arbitration or state seizure of property is provided for. In a recent decision, the United States Supreme Court held a Wisconsin law of this type to be unconstitutional. In this article the author presents some representative state laws and the highlights of the important Supreme Court verdict that may affect many of your operations

A STATUTE was enacted by the Wisconsin legislature in 1947, making it unlawful for employees of a public utility employer to strike, cause any work stoppage, slow down or interruption of an essential service; or for any public utility employer to lock out employees when so doing would interrupt essential service or to instigate, induce, conspire with or encourage any persons to engage in any strike, lock-out or work stoppage that would interrupt essential services.

This statute was part of a legislative plan intended to be effective when collective bargaining under the federal statutes failed to settle labor controversies interfering with such public services as water, heat, gas, electric power, public passenger transportation and communications.

When such a situation occurred the Employment Relations Board of the state was empowered under these statutes to appoint a conciliator to effect a settlement. In instances when such efforts failed arbitrators were to be selected to determine the controversy and their decision was final.

"The act," said the Federal Supreme Court in its recent decision holding the law unconstitutional and void, "substitutes arbitration upon order of the Board for collective bargaining whenever an impasse is reached in the bargaining process. And to insure conformity with the statutory scheme Wisconsin denies to utility employees the right to strike."

A statute corresponding closely to this Wisconsin law was enacted at this time in New Jersey, except that it substituted for the Wisconsin provision for compulsory arbitration the state seizure of the property itself.

The declaration of the state policy in this New Jersey statute is that after the taking of possession of any public utility by the state such public utility shall become for the purposes of production and operation a state facility and the use and operation of the property of the plant by the state in the public interest shall be considered a governmental function of the state.

By 1950 thirteen other states had adopted statutes substituting compulsory arbitration or state seizure for collective bargaining in labor controversies affecting public utilities.

In 1945 the workers of the country involved in the 4750 work stoppages consequent on labor controversies that year aggregated 3.5 million; the following year stoppages of this character increased to 4985 involving 4.6 million workers. In 1947 3693 work stoppages occurred through labor controversies involving 2.1 million workers.

That year to meet these situations statutes aimed at outlawing public utility strikes were enacted in Florida, Indiana, Massachusetts, Michigan, Missouri, Nebraska, Pennsylvania and Virginia besides those in New Jersey and Wisconsin. In 1920 a statute for this purpose had been enacted in Kansas and in 1943 in North Dakota.

Typical of the coverage of these

laws was the definition in the Indiana law that the term "public utility" employer means an employer "engaged in the business of rendering electric, gas, water, telephone or transportation services," or the New Jersey provision that comprehends within this term auto-busses, bridge companies, canal companies, electric light, heat and power companies, ferries and steamboats, gas companies, pipe line companies, railroads, sewer companies, steam and water power companies, street railways, telegraph and telephone companies.

Collective Bargaining

The Kansas compulsory arbitration statute covered not only public utilities but also fuel, food and clothing. In all of the states, except Nebraska and Kansas, where compulsory arbitration had been provided by legislation, statutes have affirmatively adopted collective bargaining as a labor policy.

The provisions of the Florida law in this respect were typical, pointing clearly to a trend in public opinion that would substitute this or some other and similar method than strikes as a solvent of labor disputes.

"It shall be the duty of public utility employers and employees of public utility operations to exert every reasonable effort to settle such labor disputes by the making of agreements through collective bargaining between the parties and by the maintaining thereof when made and to prevent if possible the collective bargaining process from reaching a state of impasse and stalemate."

Similar to this was the Virginia provision that, "The right of employees of utilities to organize and bargain collectively with their employers through representatives of their own choosing has long been recognized in this state and is hereby affirmed as is also the right of employers to bargain with such representatives in all matters relating to the rates of pay, wages, hours of employment or other conditions of employment of said employees but such rights cannot lawfully be exercised with respect to a public utility in such manner as to substantially impair the safety or health of the citizens of Virginia."

Legal Decisions

Shortly after this Wisconsin statute was enacted an action was brought by a local of the United Gas, Coke and Chemical Workers in the Wisconsin state court for an adjudication that this act was unconstitutional and void since its provisions were contrary to the labor statutes.

The constitutionality of the law was upheld by the Wisconsin court but in February of this year the United States Supreme Court reversed that determination, declaring the law void and in conflict with the provisions of the National Labor Relations and Labor Management Relations Acts.

In the opinion on which this judgment was made, Chief Justice Vinson said, that this anti-strike law made it unlawful for any group of employees of a public utility to call a strike, go out on strike or cause any work stoppage or slow down that would cause "an interruption of essential services." A provision of this character, he asserted, was before Congress for consideration in 1947.

At that time Senator Taft, speaking in reference to the drafting of the Taft-Hartley Act, had said of this denial of the right to strike, "We did not feel that we should put into the law as a part of the collective bargaining machinery, an ultimate resort to compulsory bargaining machinery, an ultimate resort to compulsory arbitration or to seizure or to any other action.

"We feel that it would interfere with the whole process of collective bargaining and if such a remedy is available as a routine remedy there will always be pressure to resort to it, by which every party thinks it will receive better treatment through such a process than it would receive in collective bargaining and it will back out of collective bargaining. It will not make a bona fide attempt to settle if it thinks it will receive a better deal under the final arbitration which may be provided."

The utility companies, the state of Wisconsin and other states — continued the opinion in the Supreme Court decision — stress the importance of gas and transit service to the local community and urge that predominantly local problems are best left to local governmental authority for solution.

On the other hand the labor unions and the National Labor Relations Board argue that the prohibition of strikes with a reliance on compulsory arbitration for the ultimate solution of labor disputes destroys free collective bargaining, that was declared by Congress to be the bulwark of the national labor policy.

This, it is said, leads to more labor unrest and disruption of service than is now experienced under a system of free collective bargaining accompanied by the right to strike. The very nature of the debatable policy questions raised by these contentions convince that they cannot properly be resolved by the courts.

The principle that the right to strike be denied with the substitution of compulsory arbitration in cases of local or national emergencies was before Congress in 1947, concludes this opinion. This principle, closely resembling the pattern of this Wisconsin law, was rejected by Congress as inconsistent with its policy in respect to the operation of the federal labor statutes and not because it intended to leave the states free to adopt it.

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Wisconsin Statutes, 1947, Sec. 111.63.
93 *Congressional Record*, pages 3835–3836, 1947.
United Gas, Coke & Chemical Workers of America v. Wisconsin Employment Relations Board, 38 N.W.2d 692 (Wis.) July 12, 1949.
New Jersey Annotated Statutes, 34:13B–24.
Monthly Labor Review, May, 1948.

ELECTRO-LUMINESCENCE

(*Continued from page 70*)

green at 60 cycles had a pale blue-green color at 3000 cycles. No explanation for this behavior is advanced although it may well be due to different decay rates of the phosphor components.

Spectral Energy Curves

Spectral energy curves for blue and yellow electro-luminescent lamps are shown in Fig. 6. By combining these two colors in proper proportions white lamps may be made which have spectral energy curves like that shown in Fig. 7. The color emitted by these lamps depends on the particular phosphor which is used. In general, these are of the zinc sulphide type but require special formulation and special methods of processing to make them respond satisfactorily to this new form of excitation. The usual types of phosphor such as used in fluorescent lamps and television picture tubes do not respond appreciably to this new method of excitation.

The green "Panelite" lamps have a brightness of about 0.1 footlambert at 120 v 60 cycles and from 3 to 5 footlamberts at 600 v. At 400 cycles brightness levels several times as high as these may be obtained. At present the efficiency of these lamps is a few lumens per watt. A large part of the energy consumed is taken up by dielectric losses which do not contribute to the light emitted.

Since there are no filaments to burn out, the life of these lamps should be indefinite. The end of life will undoubtedly coincide with the period when lamp brightness has decreased to a level which is inadequate rather than the usual type of abrupt termination due to filament or cathode failure. Sufficient life test data is not yet available to permit accurate estimates of probable useful life for these lamps. Indications are that it should be a matter of 2 or 3 years.

In a new development such as this, there are many questions as yet unanswered and others which cannot be answered for policy reasons. In this brief report an attempt has been made to present, in preliminary fashion at least, the more important characteristics of the phenomenon of electro-luminescence as they are known at the present time. It is apparent from the information now at hand that this method of producing light presents a new tool of tremendous potentiality.

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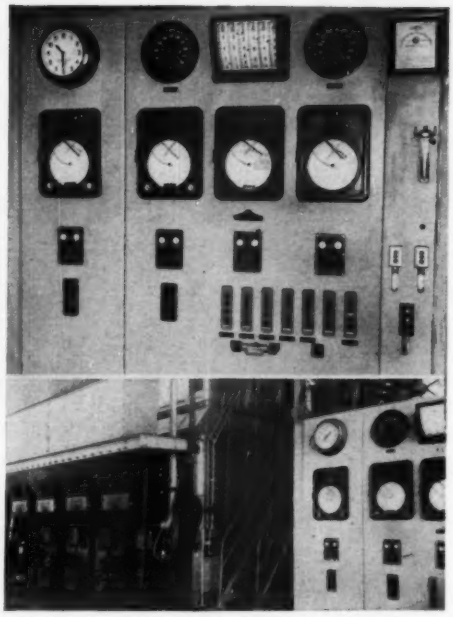

Control panel, showing completely co-ordinated Bailey Meters and Controls at Kerr Bleaching and Finishing Works, Concord, N. C.

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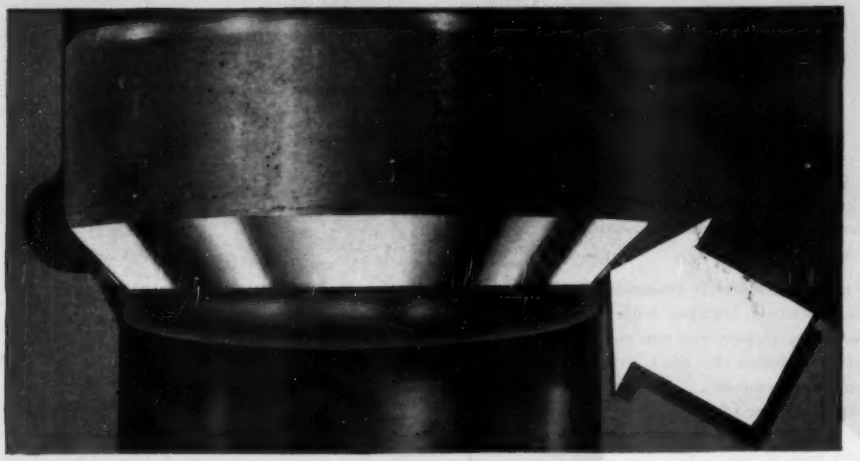

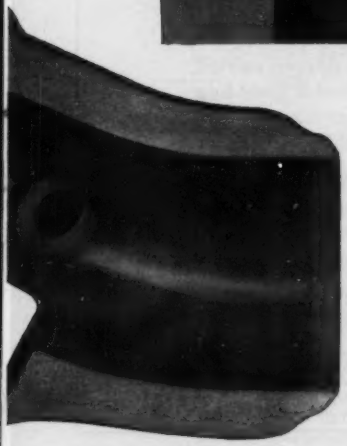

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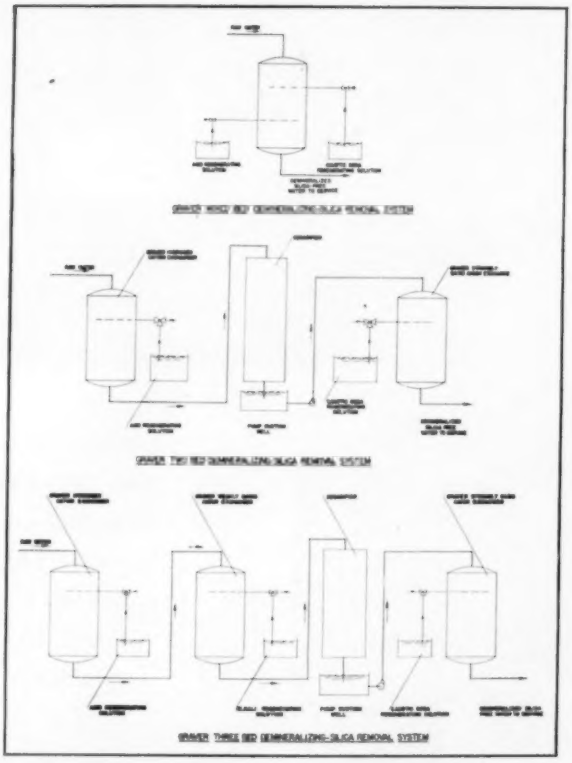

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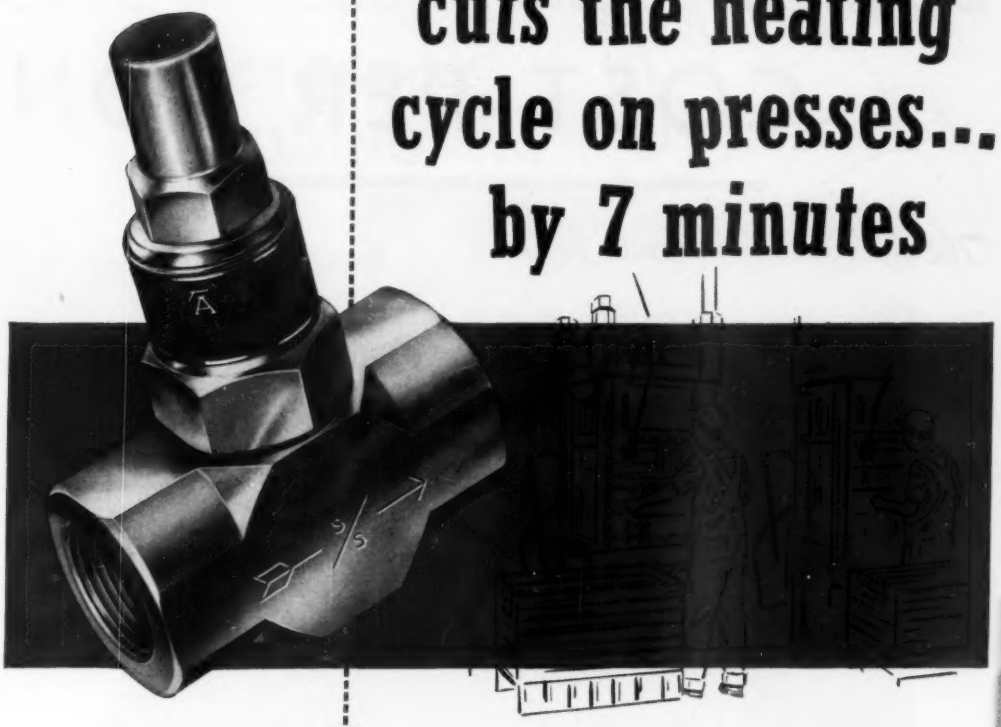

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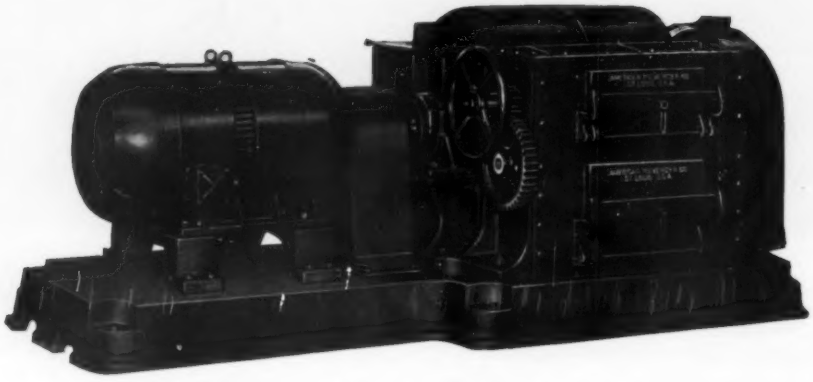

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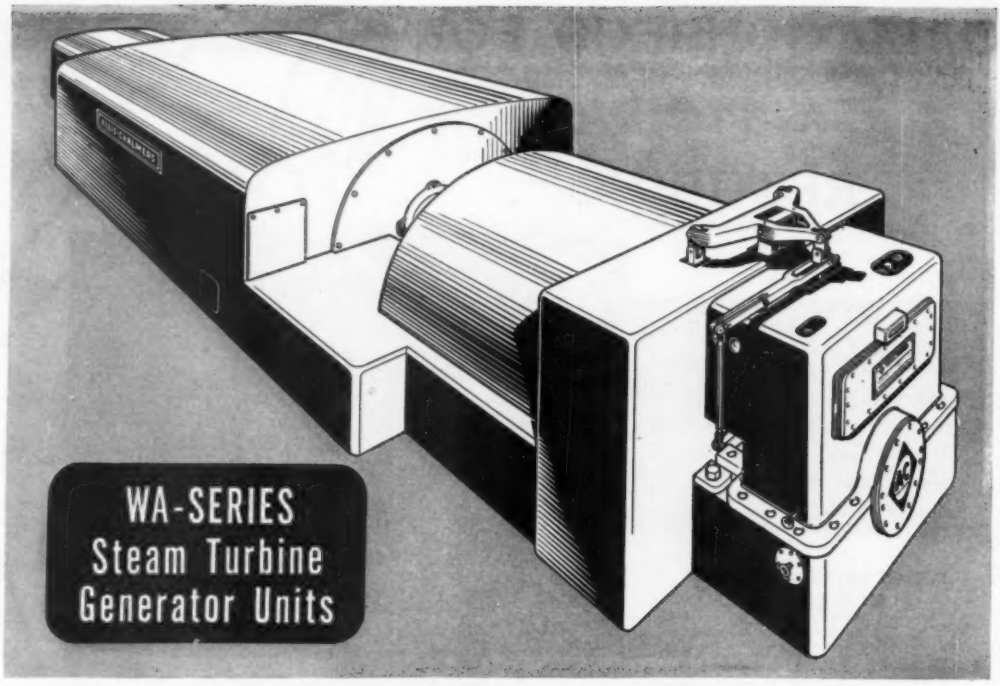

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Then a second high pressure boiler was installed. Shortly thereafter, the screen tubes of the older high pressure boiler failed because of steam blanketing. About the same time, the wall tubes of the new boiler failed at the welds, as did replacement tubing. Nothing like this had ever plagued the Superintendent before, so he called in Hall Laboratories.

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New ENGINEERING BOOKS

Electromagnetic Waves and Radiating Systems by Edward C. Jordan; 1st Edition; 710 pages; illustrated; size 6 by 8¾ in.; cloth; published by Prentice-Hall, Inc., 70 Fifth Avenue, New York 11, N. Y.; 1950; price $10.50.

This is a book of specific interest to the communication engineer, but the electrical engineer interested in all aspects of the field, power as well as communication, will find much in this book to intrigue him even though it may not be of direct practical value in his work. The power engineer is concerned more with circuits than he is with the field theory. The power of the circuit approach depends upon its simplicity and this simplicity is due to the fact that circuit theory is a simplified approximation of a more exact field theory.

Despite the power and usefulness of the circuit approach, the communications engineer concerned with microwaves or with radio transmission problems, quickly becomes aware of its limitations. In the overall design of a radio communication system, the engineer can use circuit theory to design the terminal equipment but between the output terminals of the transmitter and the input terminals of the receiver, circuit theory fails to give him answers and he must turn to field theory.

Professor Jordan's book begins with four chapters discussing fundamentals. This involves the fundamentals of electromagnetic engineering, electrostatics, the steady magnetic field and Maxwell's equations. Maxwell's equations, of course, leads to the general subject of electromagnetic waves and after discussing guided waves, transmission lines, wave guides and radiation, the book closes with a number of chapters discussing various types of antenna characteristics and the theory of ground wave and sky wave propagation. The book is designed to provide a course in this field for electrical engineers and physicists. It is an outgrowth of courses given by the author at Ohio State University and at the University of Illinois. The level of the first part of the book is suitable for seniors and beginning graduate students. Latter chapters are primarily for more advanced graduate students.

Ultrasonics, by P. Vigoureux; 163 pages; illustrated; size 6 by 9 in.; cloth binding; published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y.; price $4.00.

For those who wish to explore the more theoretical aspects of Ultrasonics, this book should prove very useful. However, considerable knowledge of mathematics is necessary to use it and since the author is a member of the Royal Naval Scientific Service in Great Britain, it is written from that point of view. That, of course, does not affect the science nor the mathematics.

Ultrasonics is, of course, the science of propagation of sound in liquids and gases at frequencies higher than are audible to human beings. The waves used are true sound waves and are not the same thing as various types of electrical vibrations.

This book first discusses the methods of generating these waves, then takes up the ways in which they are propagated through gases and liquids. Next, the author takes up the various ways in which ultrasonic energy can be detected and measured.

Finally, he describes in detail the action of ultra sound in both gases and liquids.

An extensive bibliography completes the book and there is a good index.

Industrial Wastes, by Charles H. Lipsett; 317 pages; size 6 by 9 in.; cloth binding; published by Atlas Publishing Co., 425 W. 25th St., New York 1, N. Y.; price $5.00.

This book is intended to give the reader a general knowledge of the overall picture of the production and utilization of waste material. It is not intended as a scientific work on the subject. The author has tried to use as little technical language as possible so that the average layman may understand the general processes. References are given at the end of each chapter so that those who want the full technical details may look them up in other textbooks and principally in the magazine literature of the various fields.

In order, the various chapters of the book discuss plastic scrap and its recovery, chemical wastes, glass scrap, all sorts of metal scrap, leather and wood waste, wastes from fruit, rubber, organic materials, grease, textiles, cotton wastes, woolen wastes, paper making wastes and so on.

In each case some data are given on what the wastes are and in a general way how they may be recovered.

Servomechanisms and Regulating System Design, by Harold Chestnut and Robert W. Mayer. Size 6 by 9 in.; 505 pp including index; illustrated; cloth bound. Published by John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price $7.75.

This is the first of two volumes on feedback control. The book starts from the basic mathematics, describes clearly the nature of the physical problems involved, and proceeds to the solution of advanced designs.

A listing of several of the chapter headings will give some idea of the material covered: the automatic control problem, solution of linear differential equations, methods of determining system stability, types of servomechanisms and control systems, attenuation concepts for use in feedback control system design and multiple-loop and multiple-input feedback control systems.

Volume 2, scheduled for later publication, will deal with such problems as the means of establishing design specifications as well as for reducing the effects of extraneous unwanted signal inputs and others.

Principles of Industrial Management, by L. P. Alford and H. Russell Beatty. Revised edition; size 6 by 9 in.; 759 pp; illustrated; cloth bound. Published by The Ronald Press Co., 15 E. 26th St., New York 10, N. Y. Price $6.00.

This revised edition prepared by H. Russell Beatty incorporates the many developments which have occurred in the past decade. The textbook meets the needs of those people in industry who seek a comprehensive treatment of the principles and methods used in the management of an industrial enterprise.

Some of the chapters that will be of direct interest to engineers are: control of storeskeeping, motion and time study, material and labor costs, overhead, maintenance of buildings and machinery, and industrial safety.

Special attention is given to the many changes in concepts and practices of industrial management that developed out of World War II and in the years immedi-

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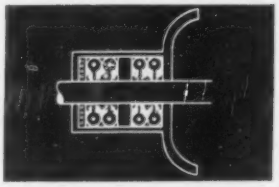

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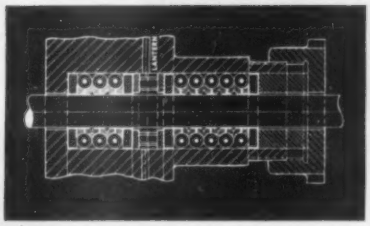

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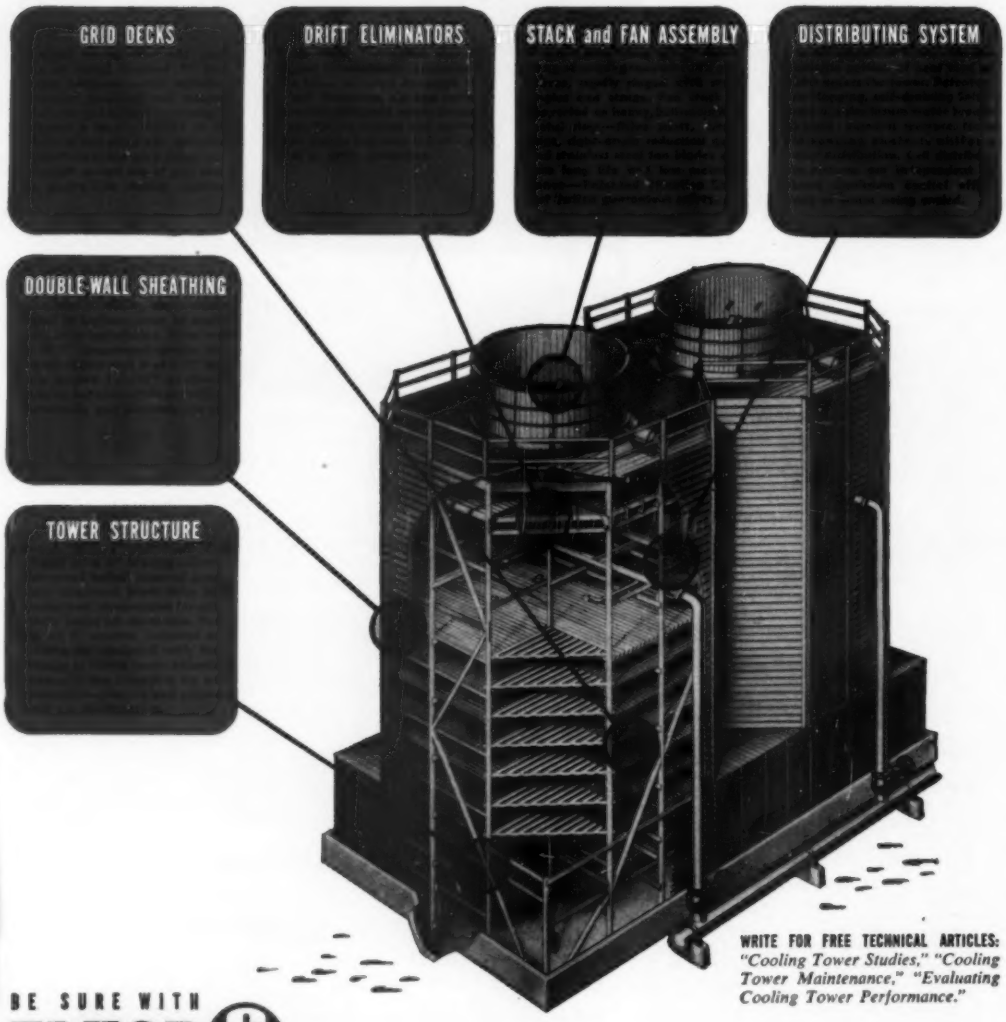

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ately following. The book features a more quantitative and factual treatment of methods, techniques and practices of management, as contrasted with the qualitative or descriptive approach.

Engineering Standards, Multiple V-Belt Drives. Size 8½ by 11 in.; 15 pp; paper bound. Available from Multiple V-Belt Drive Association, 7 W. Madison St., Chicago 2, Ill., or The Rubber Manufacturers Association, Inc., 444 Madison Ave., New York 22, N. Y. Price 50 cents.

This standards manual indicates the proper sheaves and belts to use for the attainment of optimum efficiency and economy of the complete drive in relation to the particular duty required.

The 12 tables included in this standard cover: standard groove dimensions, deep groove dimensions; standard keyseats; standard V-belt pitch lengths; measuring tensions; prime mover characteristics; suggested service factors; V-belt size for required horsepower rating; correction factors; horsepower ratings of various V-belts; and installation and take-up allowances.

Techniques of Plant Maintenance, 1951. Size 8½ by 11 in.; 223 pp; cloth bound. Published by Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y. Price $6.00.

This volume contains the proceedings of the Plant Maintenance Conference held in conjunction with the Plant Maintenance Show in Cleveland in January.

Subjects covered include preventive maintenance, inspection procedures and frequencies, records and reports, training personnel for maintenance, organization and management for maintenance, maintenance costs, incentive payment of maintenance workers, planning and scheduling maintenance operations, applied lubrication in industry, housekeeping, painting and decorating, floors and standards of sanitation.

In addition there are specialized discussions on maintenance of electrical equipment, power plant and heating equipment, problems of the small plant, selection and maintenance of lighting equipment, maintenance in chemical plants, in paper and paper products plants, in food processing plants and in metal working plants.

New Lessons in Arc Welding. Size 5½ by 8¾ in.; 312 pp; illustrated; cloth bound. Published by The Lincoln Electric Co., Cleveland 17, Ohio. Price $1.00.

This book is based on lessons and instruction given at the Lincoln Arc Welding School. The lessons are practical and cover the basic fundamentals of arc welding, as well as more advanced welding techniques in alloys, sheet metal, and pipe.

The book explains the latest welding procedures for faster and lowest cost welding; automatic and semi-automatic hidden arc welding procedures; how metals are made and how to identify them; how to select correct welding joints; how to design and make common machine parts to use welding instead of casting.

Ball and Roller Bearing Engineering, by Arvid Palmgren. Second edition; size 7 by 9¾ in.; 270 pp, including index and tables; cloth bound. Available from SKF Industries, Inc., Philadelphia, Pa. Price $1.75.

This bearing manual, translated from the Swedish, is made available to engineers, product designers, maintenance men and engineering students. It covers bearing types and nomenclature, capacities, selection, design, installation, main-

Treat Cooling Water *with Chlorine* — the Proven Way

HELP MAINTAIN MAXIMUM PLANT EFFICIENCY..

Hundreds of power plants and refineries have found chlorination by W&T the answer to heat exchanger slime problems. By eliminating slime forming microorganisms, maximum heat transfer is maintained in the condensers. The result — overall plant efficiency is kept at a maximum.

REDUCE LABOR COSTS...

High labor costs involved in frequent condenser tube cleaning are eliminated when chlorination is employed. Manhours used for tube cleaning can be utilized for other maintenance jobs, an important factor with the increasing manpower shortage.

REDUCE DOWN TIME...

Elimination of frequent shut-down for tube cleaning helps power plants stay continuously "on the line." When chlorination is employed, many plants find that outage for cleaning is reduced to once per year and then only for removing trash from tube sheets.

W & T Air Operated Visible Vacuum Chlorinator

Years of operation have proved the dependability and accuracy of W&T Chlorinators for cooling water treatment. Low maintenance and automatic program operation keep operating costs to a minimum. Your W&T Engineer is prepared to make a survey of your plant to recommend the proper chlorination equipment. Write today for more information on slime control — no obligation, of course.

CD-35

WALLACE & TIERNAN PRODUCTS, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

Belleville 9, New Jersey • Represented in Principal Cities

The New

ROTOJET

Reg. U.S. Pat. Off.

Gives you the

POWER

to clean tubes

FASTER

You won't believe any tube cleaner can pack such tremendous power, until you try the new ROTOJET. It removes scale so much faster that it usually pays for itself in one cleaning. Models available for practically any size straight and curved tubes. Send for ROTOJET Bulletin.

THE SECRET

ROTOJET Motor has only two moving parts, a shaft and a paddle. Positive contact between paddle and Rotacentric (egg-shape) bore cylinder prevents stalling at low speeds. No leakage. Delivers maximum power for air used.

S-530 ROTOJET Air-driven Motor with swing-frame head for 3¼"-3-13/16" I.D. straight tubes.

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Avenue — Newark 1, N. J.

tenance, causes of failures and load calculations.

The eight chapters cover the following subjects: common bearing types; forces and motions in bearings; carrying capacity of ball and roller bearings; bearing selection; design of bearing applications; mounting and dismounting; lubrication and maintenance; and bearing failures. The ninth chapter covers tables, conversion values, symbols and abbreviations and the book is indexed.

Tolerances for Ball and Roller Bearings, B3.5-1951. Size 8½ by 11 in.; 19 pp; paper bound. Published by American Standards Association, 70 E. 45th St., New York 17, N. Y. Price 75 cents.

This standard establishes tolerances and limits of size governing dimensional interchangeability of various types of bearings. Compliance with these tolerances should be checked in accordance with the American Standard Gaging Practices for Ball and Roller Bearings, B3.4–1950.

The standard contains 15 tables specifying tolerances on the bore, outside, diameter, width, and other characteristics of a bearing in different grades of accuracy required for various bearing applications. Types of bearings covered are: annular ball; cylindrical roller (including journal); magneto; airframe; thrust ball; industrial and airframe needle; and tapered roller bearings.

Specifications are given for the maximum permissible variation in diameter between the largest and smallest ball or roller in any assembled bearing; for the hardness of balls, rings and rollers; and for snap ring and groove dimensions.

Materials Handbook, by George S. Brady. Revised Seventh edition; size 6 by 9 in.; 913 pp including index; cloth bound. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price $8.50.

Information on over 8,800 materials is given in this revised seventh edition. The volume has been expanded to include 1500 more materials.

Part I gives the physical and chemical properties of these materials, describes substitute and alternate materials, and includes examples of just how these materials are used. It also covers certain processed materials that constitute the raw materials of some industries.

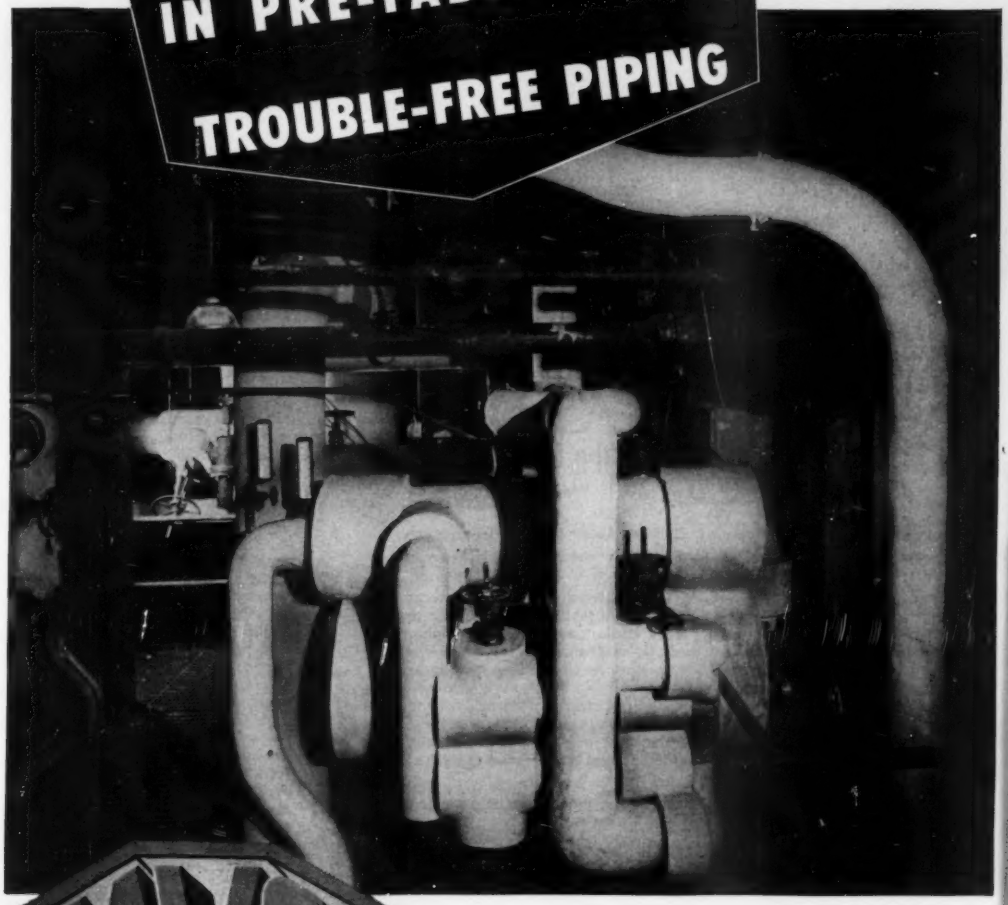
Part II contains charts, maps and tables on the world distribution and production of the materials of industry, accompanied by interpretations and analyses. This section is designed to provide economic-geographic information to industry in its planning for, designing, and purchasing of the materials it uses.

NEWS *from* THE FIELD

FOUR GROUPS TO STUDY INDUSTRIAL ATOMIC ENERGY

THE ATOMIC ENERGY COMMISSION has announced that negotiations are nearing completion with four groups of business and industrial firms for special studies of the practicability of business and industry building and operating reactors for the production of fissionable

NAVCO ACCURACY IN PRE-FABRICATION TROUBLE-FREE PIPING



NAVCO

Prefabrication accuracy is an essential "MUST" to assure a proper fit and economical operation. Navco's 40 years' experience in fabricating assemblies in all sizes and for all operating conditions is your assurance of such accuracy.

Consult Navco for your next piping job.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

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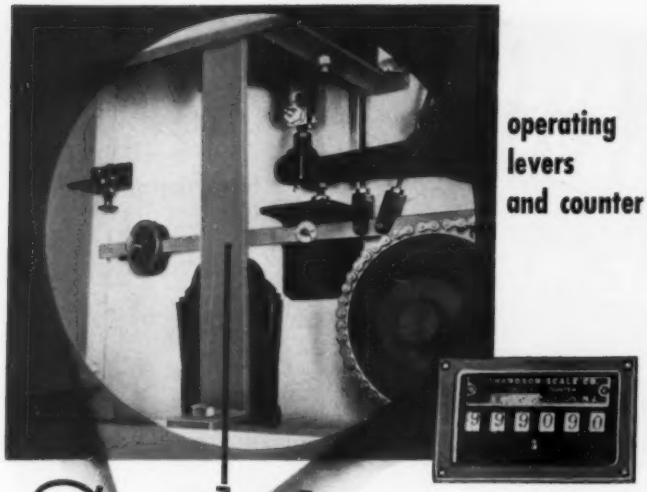


Spotlighting

LOW MAINTENANCE
LONG-TERM ACCURACY

in the **RICHARDSON** coal scale

To thousands of power installations Richardson Automatic Coal Scales mean more efficient operation through constant, accurate checks on fuel consumption.

A dust-tight, operating lever housing is another of the design features through which Richardson Coal Scales maintain really top accuracy with low maintenance. Mounted away from contaminating, coal-chamber atmosphere, operating levers are directly, mechanically linked to the heavy-duty discharge counter. Scale beam does not touch operating lever system when beam is in balance.

These design features, plus positive interlocking of mercury control switches for feeding and discharging, mean long-term accurate weighing, accurate discharge count, and no accidental by-pass feeding.

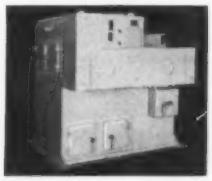
Some other features which make a Richardson an investment in coal scale reliability:

FEEDER FRAME rigidly built, with stainless steel belt-support plates, self-aligning, sealed ball bearings, and easily accessible belt tension adjustment.

FEEDER BELT endless or laced, 22" with molded flange, 2-ply for 200-lb. discharge capacities, 4-ply for greater.

BELT SCRAPER correctly spring-loaded to apply sufficient pressure for removal of sticky, wet coal without causing belt wear.

ELECTRICAL CONTROLS fully enclosed *outside* corrosive coal chamber for long life, low maintenance.



3 BULLETINS AVAILABLE

Send For Them Today For Complete Information On: EE-39, for dust-tight normal service—200-300 lbs. per discharge—**Bulletin No. 0150.**

Model K-39, for pressure-tight (up to 60" of water), large-capacity service—400-500 lbs. per discharge—**Bulletin No. 0250.**

Monorate, non-segregating coal distributor—**Bulletin No. 1349.**

Richardson

8103

MATERIALS HANDLING BY WEIGHT SINCE 1902

RICHARDSON SCALE COMPANY
Clifton, New Jersey
Atlanta • Boston
Buffalo • Chicago • Cincinnati
Detroit • Houston • Minneapolis
New York • Omaha • Philadelphia
Pittsburgh • San Francisco • Wichita
Montreal • Toronto

materials and power. They were submitted by:

The Monsanto Chemical Co., St. Louis, Mo. and its associate, The Union Electric Co. of St. Louis, Mo.

The Detroit Edison Co. of Detroit and the Dow Chemical Co. of Midland, Michigan.

The Commonwealth Edison Co. and the Public Service Co. of Northern Illinois, of Chicago.

The Pacific Gas and Electric Co. and the Bechtel Corp. of San Francisco, Calif.

Agreements have already been signed with the Dow Chemical-Detroit Edison group and with Commonwealth Edison-Public Service of Northern Illinois group. The Pacific Gas and Electric-Bechtel group has indicated its acceptance of the agreement. Negotiations are continuing with the Monsanto Chemical Co., and the Commission expects early closing of the agreement with it.

These study projects do not include a special proposal by the Bendix Aviation Corp. of Detroit, for study of a reactor for the production of isotopes to be built with private funds. The Bendix proposal is now in a preliminary discussion stage.

In general, the terms of the agreements provide that the companies will make a survey and study of the Commission's reactor development activities.

(1) To determine the engineering feasibility of their designing, constructing, and operating a materials and power-producing reactor.

(2) To examine the economic and technical aspects of building this reactor in the next few years.

(3) To determine the research and development work needed, if any, before such a reactor project can be undertaken.

(4) To offer recommendation in a report to the Commission concerning such a reactor project and industry's role in undertaking and carrying it out.

Maximum time permitted for the study is 12 months after signing of the letter agreement.

All costs will be borne by the companies with the exception of costs to AEC and its contractors incidental to making information and consultation services available.

Editor's Note:—This participation by industry may give atomic energy projects a new twist; it reverses the atomic energy emphasis.

It is generally agreed that the results of these studies will not, in the foreseeable future, render present plant equipment obsolete or affect present power plant investments during their economic life.

BEGIN INSTALLATION OF 145,000-KW UNITS AT KEARNY

WORK HAS STARTED at Kearny Generating Station of Public Service Electric and Gas Co. (New Jersey) on the installation of the largest

Why Phosphorized Admiralty Condenser Tubes?

...OUTSTANDING RESISTANCE TO DEZINCIFICATION

Adding as little as 0.02% phosphorus to Admiralty greatly increases its resistance to dezincification, without impairing its excellent chemical and physical properties.

In power plant service, Scovill Phosphorized Admiralty Tubes have given very satisfactory trouble-free life, proving relatively immune to dezincification and highly resistant to attack by steam and condensate and to general corrosion in fresh, salt or brackish circulating waters.

In order to assure *uniform* chemical composition and *soundness*, Scovill produces its Phosphorized Admiralty tubes by the *continuous* billet-casting process which continuously maintains the optimum amount of phosphorus. The tubes are hot-extruded from the continuous-cast billets, then are cold-drawn, annealed, cleaned and finished to produce tubes of uniform temper, gauge, straightness, roundness, diameters, length and freedom from burrs.

A Condenser Tube Booklet is available to qualified users who request it on their business letterhead. Scovill Manufacturing Co., 15 Mill St., Waterbury 20, Conn.

Only Scovill Phosphorized Admiralty Has All These Advantages ...

- Uniformity and soundness resulting from Scovill continuous-casting techniques
- Relative immunity to dezincification
- Excellent performance in fresh, salt or brackish waters
- High resistance to steam and condensate
- Unquestioned heat transfer characteristics
- Superior resistance to general corrosion
- Good resistance to velocities under 7 fps.

SCOVILL CONDENSER TUBES
"You can't buy better brass"

SCOVILL

A PRODUCT OF SCOVILL

With This NEW Improvement Niagara "No-Frost Method" puts you a big step ahead in trouble-free, automatic refrigeration or freezing

Niagara "No-Frost Method" keeps frost and ice COMPLETELY OUT of your cooling, chilling, freezing or cold storage.

It uses Niagara No-Frost Liquid Spray to keep frost and ice from ever forming. It gives you, automatically, refrigeration with no defrosting, and full capacity NEVER cut down by ice building up progressively on refrigeration coils.

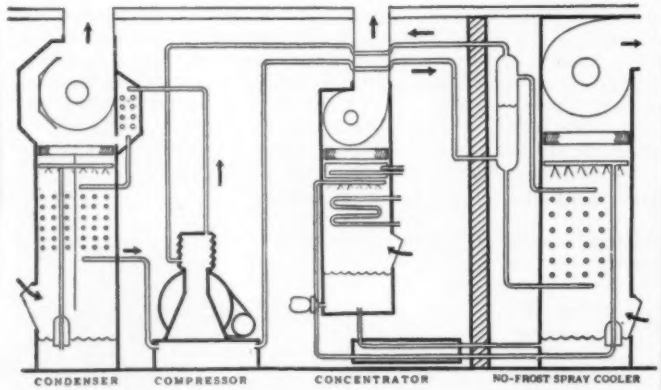
Now, a NEW design No-Frost Liquid concentrator, using a new principle, takes away moisture as fast as it is condensed by evaporating it at low temperature — not boiling it away at high temperature. It has 14 times the capacity of the old method per dollar of investment — one concentrator will handle a battery of high capacity spray coolers.

This gives you more refrigeration at lower cost; less machinery in less space. You operate at high suction pressure, saving power and wear and tear on compressors.

The extra capacity and lower cost both for equipment and operating makes this method advantageous for every type of refrigeration use — both for freezing and for moderate temperatures — for large "live" loads as in meat chilling or in fruit and vegetable pre-cooling — for rooms that are filled and emptied of product daily, such as milk rooms and terminal storage warehouses.

You get true trouble-free refrigeration . . . No brine . . . no salt solution . . . no dirt . . . no mess . . . It is entirely clean; you get rid of dirt and odors. You reduce both equipment and operating costs.

For complete information write to the Niagara Blower Company, Dept. E, 405 Lexington Avenue, New York 17, New York.



A simple method, easily maintained. Saves a third of your refrigeration cost. Ask for Niagara Bulletins 118 and 119.

turbine generators in the company's electric system. The new installation, when completed, will consist of two 145,000-kw, high-pressure, high-efficiency generating units and the necessary auxiliary apparatus.

The first unit is expected to be placed in service in the Fall of 1952 and the second unit in the Spring of 1953.

The new Kearny Station will have a capacity of 290,000 kw, bringing the total generating capacity at this site to 624,000 kw.

Each of the 145,000-kw turbine-generators will be supplied with high-pressure, high temperature steam at 2350 psi and 1100 F by a single large boiler capable of evaporating 525 tons or 1,050,000 lb of water per hour. This steam, after passing through several stages of the turbine is returned to the boiler and is re-superheated to 1050 F and then re-enters the turbine.

An unusual feature of these boilers is that water is circulated through the steam-producing tubes by means of special circulating pumps.

The boilers will be equipped to burn either pulverized coal or fuel oil, or both simultaneously.

The turbine-generators will be of the tandem compound, condensing type, having a capacity of 145,000 kw. Surface condensers having an area of 70,000 sq ft will be installed. Condensing water will be pumped through each condenser at the rate of 100,000 gpm.

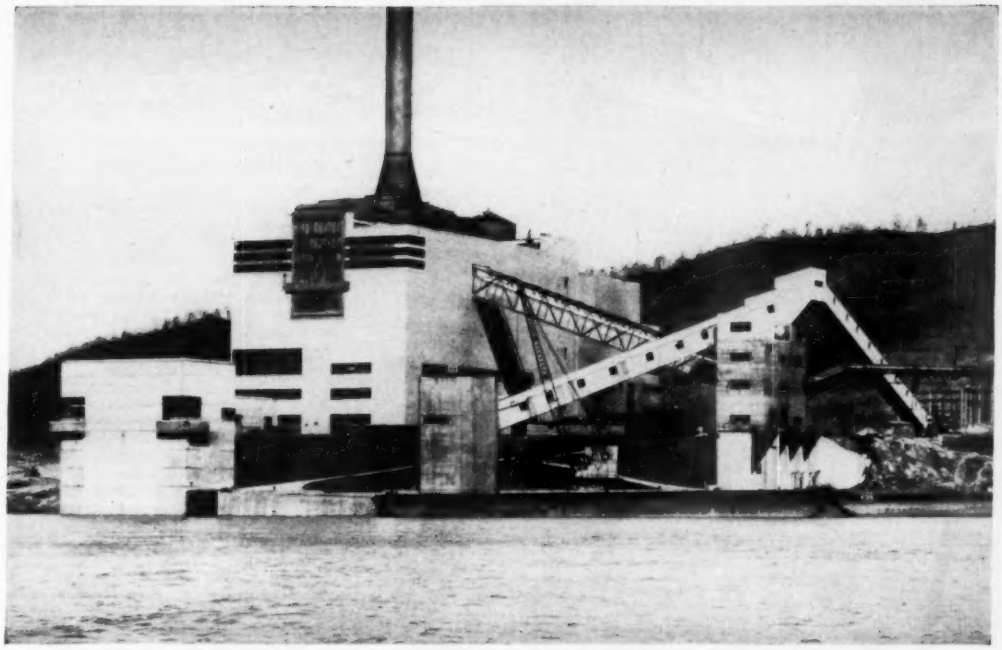
The electric generators will be cooled by hydrogen at 30 psi.

Upon completion of the installation, these two units operating together will produce one kilowatt-hour of electricity from $\frac{2}{5}$ lb of coal.

Obituaries

F. O. McMILLAN

F. O. McMILLAN, head of the Electrical Engineering Department, Oregon State College, Corvallis, Oreg., whose election as 1951–52 president of the American Institute of Electrical Engineers, was announced at the Summer General Meeting of the Institute at Toronto, Can. A native of Albia, Ia., Prof. McMillan holds a bachelor of science degree in electrical engineering from Oregon State College and a master of science in electrical engineering from Union College. Prior to his appointment to the faculty of Oregon State College in 1920, he was employed by the General Electric Co. In addition to his academic work, Prof. McMillan has been active as a consulting engineer for a number of public utilities, including the Port of Portland and the United States Bureau of Fisheries. He has been an Institute member since 1914 and has held several Institute Posts. He also is a member of



Unique Circulating Water System Installed in This Power Plant

The R. E. Burger steam-electric plant of Ohio Edison Company is located on the Ohio River well above flood stage—which may reach as much as 60 feet above extreme low water. Water is supplied to the condensers by a patented circulating water system pioneered jointly by Worthington and the consulting engineer, Mr. George W. Saathoff.

All major equipment except circulating pumps, which are designed to operate completely submerged if necessary, are located above flood stage.

The new installation of a Worthington 70,000 sq ft two-pass condenser and auxiliaries, serving a 90,000 kw turbine-generator, is the third Worthington unit in this station. Two 46,000 sq ft condensers were previously installed.

For advice on any new installation or information on a wide range of power plant equipment, consult Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

HOW IT WORKS

Two full-capacity circulating pumps are used in series.* The primary pump, submerged below extreme low water, is a Worthington motor-driven HIFLO. Its high starting head characteristic is able to deliver enough water for starting purposes. A booster pump—a single-suction volute Worthington MI-AFLO, mounted directly upon an hydraulic turbine—starts when there is enough water in the control well. The two pumps then operate automatically in series at full capacity.

Advantage is taken of maximum siphon effect from the condenser drop leg which enters the sealing or control well. From this well, all circulating water is passed through the hydraulic turbine. Thus the static head from sealing well to river level is utilized—75-80% being recovered—in reducing the work of the primary pump, with saving in overall pumping power.

The booster pump functions until rising water renders the turbine ineffective. Then the primary HIFLO works alone, producing full capacity under reduced head.

*In the new unit, there are two half-capacity primary pumps, permitting operation of only one in the winter when low water temperatures prevail.

Z.1.1

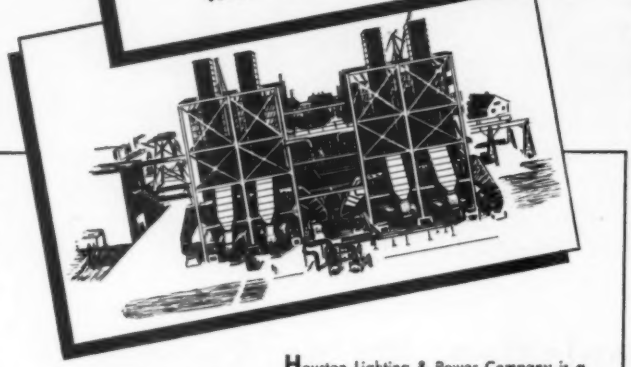
WORTHINGTON

WORLD'S BROADEST LINE OF STEAM POWER PLANT AUXILIARIES

Feed Water Heaters	Boiler Feed Pumps	Steam Turbines
Steam-Jet Ejectors	Water Treating Equipment	Surface Condensers

GO on GREEN

4 Green Forced Draft Fans
4 Green Induced Draft Fans
...Serve the West Junction Plant of
Houston Lighting & Power Company



Houston Lighting & Power Company is a leading factor in the power field of the great southwest. That it approved the selection of Green Draft Fans by the boiler manufacturer — in this case Riley Stoker — is evidence of high acceptance in the field. No utility can afford to operate with inferior or unsuitable equipment at any point. It must have equipment that is not only highly efficient but right.

To Houston Lighting & Power can be added other well-known recently completed utilities that are Green Fan plants, among them the following:

Central Hudson Gas & Electric Co.
Atlantic City Electric Co.
Virginia Electric & Power Co.
Monongahela Power Co.
Louisiana Power Light Co.
Kansas Gas & Electric Co.
El Paso Natural Gas Co.
Pacific Gas & Electric Co.
South Carolina Public Service Authority
Buffalo Niagara Electric Corp.

With utilities as with industrial power plants, it's safe to "Go on Green" when it comes to draft fans.

Our Catalog No. 168 tells all about Green Fans. Write for a copy.

THE GREEN Fuel Economizer COMPANY INC.
BEACON 3, NEW YORK

ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

the American Association for the Advancement of Science, American Society for Engineering Education, Institute of Radio Engineers, Northwest Electric Light & Power Association, and the Professional Engineers of Oregon.

FRANK S. SCHUYLER

FRANK S. SCHUYLER, retired manager of Allis-Chalmers Detroit district office, died June 10 following a brief illness. He was 66.

Mr. Schuyler completed 30 years as manager of the company's Detroit district before retiring on December 31, 1950 after 43 years of continuous service with Allis-Chalmers.

Mr. Schuyler joined Allis-Chalmers in 1907 after graduating from Penn State College with an electrical engineering degree. Upon completion of a student training course, he was assigned to the San Francisco office in 1909 as a correspondent. A year later he became a salesman in the San Francisco office and served in that capacity until 1911 when he was transferred to the Los Angeles office. He remained there as a salesman until January, 1919, when he transferred to the Pittsburgh district office. A year later he was appointed manager of the Detroit district.

Mr. Schuyler's affiliations included the Economic Club of Detroit and the Engineering Society of Detroit.

JOHN M. HOPWOOD

JOHN M. HOPWOOD, of Pittsburgh, chairman of the board of the Hagan Corp. and its subsidiaries, died Friday, June 8, after a lengthy illness. Death occurred in Vero Beach, Fla., where he had been at his winter home for several months. He was 67. Other companies of which Mr. Hopwood was head and co-founder were Hall Laboratories, Inc., Calgon, Inc., and the Buromin Co.

Mr. Hopwood was a moving spirit in the expansion of Pittsburgh's Shadyside Hospital. President of its board of trustees from 1941 to 1948, and a board member since, he contributed generously of his own funds in addition to sparking its fund-raising campaigns. He is survived by his wife, formerly Miss Grace Whitford, of Somerset, Pa., two sons, John M., Jr., and William W., a daughter, Mrs. Daniel Richardson, and six grandchildren.

Mr. Hopwood's career was a "success" story in the best American tradition. A newcomer from Wales at 21, he built a great Pittsburgh corporation which, with its subsidiaries, has influenced industrial and marine steam generating practice throughout the world and has contributed to the knowledge of water usage and treatment.

Knowing the great damage caused to boilers by rust and scale, Mr. Hopwood set up and financed a research program in cooperation with

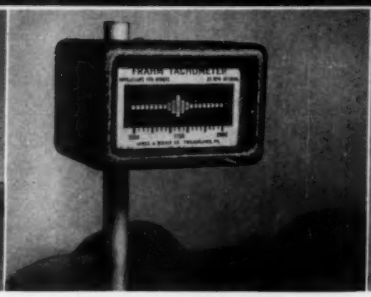
BIDDLE
Instrument News

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

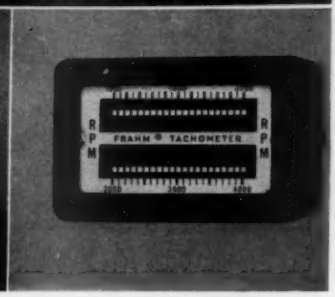
NUMBER 6 OF A SERIES

JAMES G. BIDDLE CO., 1316 ARCH ST., PHILADELPHIA 7, PA.

Type T-21



Type T-21 mounted with a Cat. 2406 Bracket



Type T-22

MEASURE SPEED BY RESONANCE — Touch or Permanent Mounting
FRAHM® RESONANT REED TACHOMETERS

The Miniature Frahm instruments shown above weigh about 12 ounces and measure approximately 3″ x 2″ x 2¾″. The T-22 affords double the rpm range of the T-21. Various speed ranges are available from 1000-1500 to 9000-13,000.

The phenomenon of resonance activates the delicately tuned reeds when touched to any part of a rotating machine or when permanently mounted. 60° or 90° brackets are furnished where mounting is desired. In confined spaces, the convenience of merely touching the instrument to any part of the machine casing is highly desirable and a considerable safety factor.

Since there are no movable parts in Frahm Resonant Reed Tachometers there is nothing to require maintenance. They are built to take rugged handling.

Frahm Tachometers are made in a variety of shapes and sizes with splash-proof cases and reeds tuned to guaranteed accuracy within 0.5%.

Write for Bulletin 31-PE.

SPEED COUNTER AND STOP WATCH COMBINED
JAGABI® TACHOSCOPE

Measurement of Speed and Time are combined in the Tachoscope in such a way that the usual error in starting and stopping is eliminated. Higher accuracy of calculation is assured because of the longer time the Tachoscope can be operated. It is a highly precisioned instrument for machine speeds up to 20,000 rpm. In fact, many use it as a standard for checking other speed measuring instruments. The high-grade stop watch can be used independently.

SPEED MEASURING BULLETIN

A selection chart of Speed Measuring Instruments for specific conditions is a feature of Bulletin 35-PE. Mailed on request.

WIDE RANGE PRECISION HAND TACHOMETER
THE DR. HORN TACHOMETER

We are now prepared to make immediate delivery of this instrument, considered by many to be the ultimate in a fine speed measuring device. Pointer affords instantaneous reading of rpm of rotating shafts, or linear and peripheral speeds, regardless of direction of rotation. Measures in six ranges from 25 rpm to 30,000 rpm. Protected against overspeeding damage. Operates equally well in a vertical, horizontal, or slanting position. Simple mechanism. Low maintenance. Long life.

James G. Biddle Co. is the sole distributor and authorized service agency for these highly regarded instruments.

Write for Bulletin 35-65-PE.

DARTS give a TIGHT JOINT

Without Excessive Wrenching!

Brutal wrenching is never necessary with a Dart Union. Both bronze seats—accurately machined then spherically ground—have wide, true-bearing surfaces that always give a drop-tight joint. No need to jam a Dart; no need to question but what it will stay tight.

And, because body and nut are made of practically indestructible, high-test, air-refined malleable iron, you can be sure they'll laugh off rough abuse—give the vital joint the ultimate in protection.

Little wonder Darts are first choice of shrewd buyers coast to coast.

DART UNION COMPANY
Providence 5, Rhode Island
The Fairbanks Co.—Distributors
Boston New York Pittsburgh

DART UNIONS

the U. S. Bureau of Mines which, after four years, found the answer to this problem in an almost forgotten chemical. Then, to permit the widest possible use of the knowledge gained and to continue basic research on problems caused by water, he established Hall Laboratories, Inc., a firm of industrial water consultants, and Calgon, Inc., to develop and market such products as Calgon, a water conditioner used in commerce, industry and the home, and a number of allied compounded products.

INDUSTRIAL PLANT POWER SOURCES

(Continued from page 92)

at both 425 and 165 lb per sq in., as required in the process work. The exhaust pressure is 25 psi. Exhaust from the turbine driven boiler feed pumps and forced draft blowers to to the 25 psi mains, the steam from which is used for boiler feedwater and building heating and for miscellaneous services.

It is clear that one commonly used measure of power plant investment, namely, *cost per kilowatt installed*, is not applicable to plants of this type. In a base-loaded central station, the boiler capacity installed at the Dow plant could furnish steam enough to generate approximately 90,000 kw as compared to the 30,000 kw actually installed at Dow Chemical. Computing the cost per kilowatt on the basis of the installed generating capacity in the plant such as the South Power Station, would result in a figure that would be inordinately large and hence misleading.

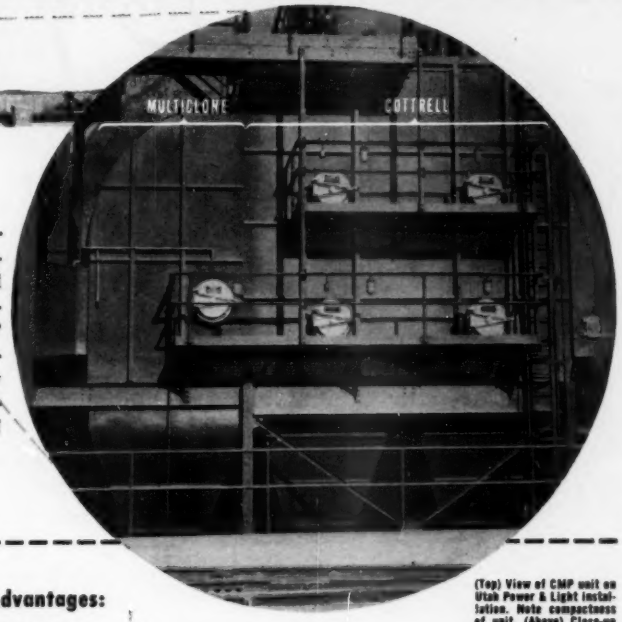
Means of providing heat for process other than by steam boilers and turbines are also in use in some plants. One notable installation is that of a mercury boiler and turbine at the Pittsfield Works of the General Electric Co. In this case, additional power and a considerable amount of steam at 640 psi were required. The use of a 7500 kw mercury unit power plant permitted the generation of 7500 kw of power and 113,000 lb of steam per hr and the required ratio of electric power to steam production was obtained. No steam turbine topping unit could have met these requirements.

Figure 2 shows a heat balance diagram at rated load for the Pittsfield installation. Note that the ratio of electric generation to steam produced is 66.5 kwh per 1000 lb steam. Passing the steam flow from the mercury unit to the existing extraction turbines results in a net overall heat rate of 10,800 Btu per kwh or a thermal efficiency of about 32 per cent, which is remarkable for a plant of this capacity.

The gas turbine also offers some interesting possibilities for generating power and furnishing heat requirements. Although no industrial applications have been made to date, one central station installation, the Belle Isle Station of the Oklahoma

Planning A Fly Ash Recovery Installation?

Consider these important advantages of a WESTERN PRECIPITATION CMP UNIT!



IF YOU are planning the installation of any type of fly ash recovery equipment—mechanical or electrical—it will pay you to investigate the extra advantages to be gained by installing a CMP Unit designed, engineered and constructed under *one* responsibility by Western Precipitation Corporation—*leaders in both electrical and mechanical recovery fields!*

(Top) View of CMP unit on Utah Power & Light installation. Note compactness of unit. (Above) Close-up of same installation.

Combines Mechanical and Electrical Advantages:

A CMP (Combination Multiclone-Cottrell Precipitator) Unit combines—in one compact installation—both mechanical and electrical recovery principles, so that maximum benefit is obtained from the advantages inherent in each method. The MULTICLONE section centrifugally cleans the gases of the larger and heavier fly ash particles (down to a few microns in diameter) . . . and the COTTRELL Precipitator then electrically removes the very small particles remaining in the gases. This combination arrangement has important advantages:

1. Using the MULTICLONE for cleaning out the heavier particles permits the bulk of the recovery operation to be performed with relatively low-cost equipment.

2. Using the COTTRELL for final clean-up insures unusually high recovery efficiency—approaching theoretically perfect, if desired—with a high efficiency, compact Precipitator unit.

3. Each type of unit—MULTICLONE and COTTRELL—can be arranged for its most efficient application. MULTICLONES may be connected to each separate boiler, if desired, and their draft requirement cut out when the boiler is down . . . while a central COTTRELL handles all gases and operates at higher efficiencies, with continued low power cost, when one or more boilers are down.

4. During soot-blowing periods, or while warming up cold boilers, the MULTICLONE efficiency usually increases, preventing overloads of detrimental carbon from reaching the COTTRELL.

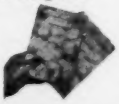
Only Western Precipitation Combines Multiclone and Cottrell "Know-How"—In ONE Organization!

A vital factor in obtaining maximum efficiency and economy in CMP installations is the proper balance of mechanical and electrical recovery equipment to the individual requirements of *each* application. Western Precipitation is unique in that it not only pioneered the commercial application of COTTRELL Electrical Precipitators over 43 years ago, but also has been a leader for many years in the *mechanical* recovery field with its widely-recognized MULTICLONE Collectors.

Result—Western Precipitation has the all-important "know-how" and experience in BOTH fields . . . knows from first-hand experience how to fit the *right* equipment in the *right* place, to do *your particular* job . . . and can provide the complete installation under ONE responsibility and ONE overall guarantee!

Let Our Experienced Engineers study your recovery requirements and make recommendations on the equipment best suited to your operations. A wire, phone call or letter to our nearest office places this unique "Know-How" at your service, without obligation!

Send for descriptive literature!



WESTERN Precipitation CORPORATION

ENGINEERS, BUILDERS & MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1029 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA
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PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

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● A new 12-page booklet on Turbine Oil Maintenance has been prepared under the direction of Edwin M. May, a nationally recognized authority on lubrication engineering. A member of the Bowser sales engineering staff for many years, he has an M. E. Degree from Purdue, is Chairman of the New York Section of A.S.L.E., is a member of the Petroleum Applications Committee of A.S.M.E. and the Turbine Oils Committee of A.S.T.M.

● ● ●

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BOWSER, INC., 1351 Creighton Ave., Fort Wayne 2, Ind.

Please send new Turbine Oil Conditioning Booklet

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

Gas and Electric Co., has been operating for more than a year. This installation involves the use of a simple cycle gas turbine, in conjunction with a recuperator used for feedwater heating from turbine exhaust gases. Operating in conjunction with the steam station, the gas turbine reduces the overall heat rate and increases the total capability. An increase of 7400 kw in total capability for station at maximum load was obtained at an installed cost of less than $100 per kilowatt. The incremental heat rate for the gas turbine unit is 12,000 Btu per kwh.

Thus far the gas turbine has not been able to compete with efficient steam or Diesel generating plants because of high first cost of units with efficient heat cycles. But where low

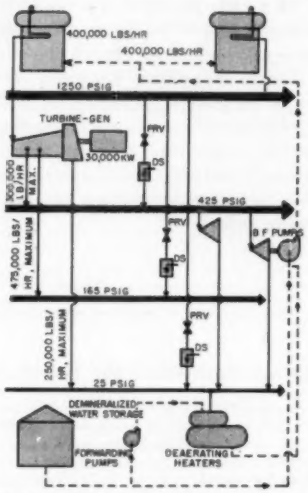


Fig. 1. Simplified flow diagram, South Power Station, Dow Chemical Co.

cost gas or oil is available a simple cycle low cost gas turbine may have a place, particularly if heat can be recovered from the exhaust gases.

Sometimes cases arise, especially in connection with chemical plants,* in which an excess of power over and above the plant requirements can be generated economically by the steam needed for process purposes. When such a condition occurs, an arrangement can often be worked out with the local public utility company to sell the excess power to it at a cost in return for a stand-by connection without the usual expensive charge.

In other cases, the public utility undertakes to furnish steam for process use as well as power. A good example of such service is that of the Gulf Utilities Co. sales to the industrial area of Baton Rouge, La. In another instance, an industrial

*Editor's Note:—At least one chemical plant, to our knowledge, has some chemical reactions generating heat that is transferred into molten salt. This is pumped to heat exchangers, producing steam or hot water for use in other processes.

VULCAN AUTOMATIC-SEQUENTIAL SYSTEM *for* TITUS STATION

of METROPOLITAN EDISON COMPANY

METROPOLITAN EDISON COMPANY a Vulcan user at Crawford and Eyler Stations, has now swung to fully automatic-sequential Vulcan soot blowing for Titus Station.

Standing at the control panels, adjacent to all other boiler instruments, the operator now does the complete soot-blowing job by merely pushing a single button.

Operation of the Vulcan system is right before his eyes. He can see at a glance that each unit automatically cuts into operation at the right time and pressure, blows for the proper period, and cuts out of service. If any unit requires more—or—less frequent blowing, the control is at his fingertips.

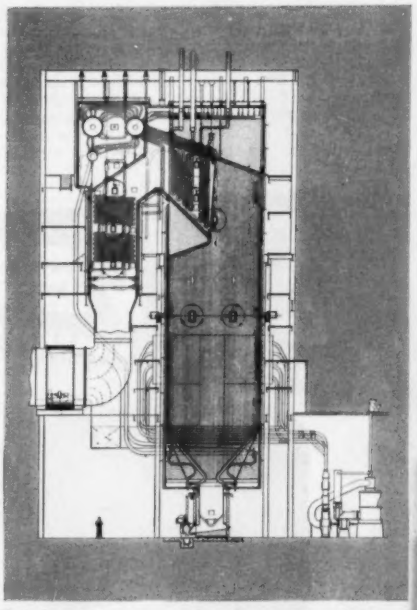
There is no need to waste time or effort climbing to remote locations—no excuse for forgetting to blow on schedule.

A Vulcan Automatic-Sequential System is designed to clean boilers better at lower cost. Bulletin 483 tells the story. Write for it.

VULCAN SOOT BLOWER DIVISION

Continental Foundry & Machine Company

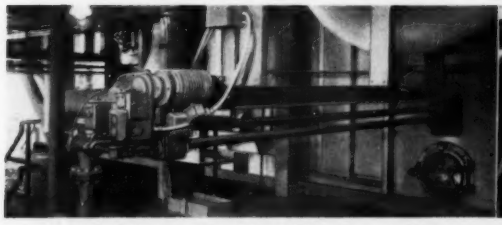
DUBOIS, PENNSYLVANIA



Units 1 and 2 are now in service at Titus Station of Metropolitan Edison Company, near Reading, Pennsylvania. Each boiler was built by Combustion Engineering-Superheater, Inc., with capacity of 510,000 pounds per hour at 1450 psi and reheat to 1010 F. Firing is with pulverized coal.

Boiler cleaning is by Vulcan, with fully automatic-sequential control. Each boiler has ten electric-driven long-retractable soot blowers, eight air-driven wall blowers, and controls for two electric-driven air heater blowers. Blowing medium is air.

Consulting engineers: Gilbert Associates, Inc.



One of ten Vulcan Long Retractable Blowers, Unit 1

Two of the eight Vulcan Wall Blowers on Unit 1

VULCAN *Automatic Soot* **BLOWERS**

center in East Newark, N. J. supplies steam and power to 40 independent and diversified manufacturing firms within a small area.

Plant Having Heat Available From Process

Many chemical plants, paper plants, sugar cane refineries, saw mills and the like may have heat available in some form or another. However, the steel industry tops all of these industries in this respect and the discussion here will be confined to this industry alone.

A large and well-integrated steel plant will have waste heat and by-product fuel in the shape of blast furnace gas and coke oven breeze over and above the plant needs, and this fuel can be burned in boilers to produce a large amount of power. Coke oven gas and tar may also be available but it is usually more economical to burn this fuel elsewhere in the plant or to sell it. Considerable low pressure steam is required for process and heating, and the demands for power are also very large. Designing a suitable power house for such a plant will necessitate a thorough knowledge of all steam and power demands, as well as of the by-product fuel availability.

Ordinarily, it will be found advisable to generate steam with the by-product fuel up to the maximum at all times. It will usually be desirable to generate this steam at some higher pressure than would be needed in the plant and supply the plant steam requirements through non-condensing turbine generators, thus obtaining a portion of the plant power requirements at a very low heat rate. The balance of the high pressure steam can then be used to generate power in condensing steam turbine generators.

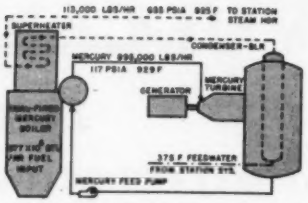


Fig. 2. Simplified heat balance at rated load, General Electric Co., Pittsfield, Mass.

An excellent example of steel plant power production is that at the Carnegie-Illinois Steel Corp. Here they are just completing an installation which consists of a 650,000 lb per hr steam generator and a 60,000 kw turbine generator. The boiler burns blast furnace gas and the steam blast furnace gas and the steam conditions are 1025 psi and 900 F. The turbine generator exhausts at 29 in. of vacuum with five bleed points for feedwater heating. As in the case of the Dow plant, hydrogen cooling is used in the generator.

Very Large Power Requirements

Some industries are such large consumers of power that their demands are comparable to those of public utilities. These industries may elect to generate their own power requirements on the grounds that they can build the necessary power plants at as low costs and operate them as efficiently as the public utilities. If the needs of any industry dictate the location of its plants at points where large blocks of public utility power are not available except over long transmission lines, the proposition becomes increasingly attractive, particularly if extreme reliability of service is of prime importance in the operation of the plants.

The electro-chemical industry is characterized by its disproportionately large use of power as compared to other types of industries. In this group, the aluminum industry is one of the best examples because of the large amount of power needed to reduce the oxide of aluminum to metal; very low cost power is essential in order to produce the metal at reasonable cost. In the past, the demands were met by the construction of hydroelectric plants, at first by private enterprises, and more recently by government agencies. However, the unprecedented de

Solved...
A SOOT BLOWER PACKING PROBLEM
with the RIGHT combination of
"JOHN CRANE" PACKING
Problem: Leakage caused by packing vulcanizing and hardening where temperatures were over 400° F.
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Results: Over six months of service, as compared to one or two weeks service from the rubberized fabric-type packing formerly used.
Field Engineers in over 32 U.S. and Canadian Offices are trained to understand and solve your packing problems. They are always ready to assist you.
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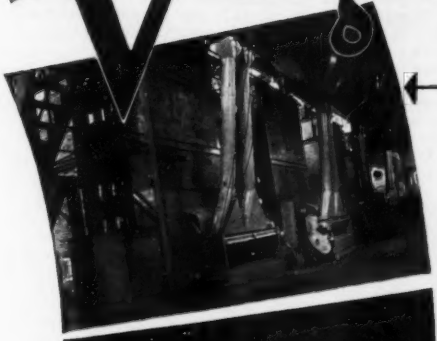
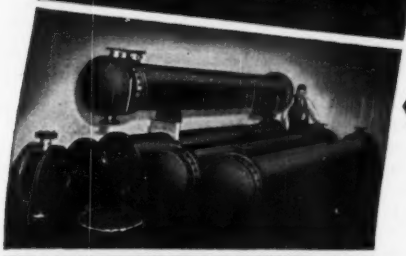


EFFICIENT AND DEPENDABLE STEAM GENERATION

Vogt steam generating units are designed to give maximum rating in a minimum of space with high efficiency and low maintenance expense. Bent tube types and straight tube, forged steel sectional header types to burn solid, liquid or gaseous fuels, as desired, meet every power, heating or process requirement.

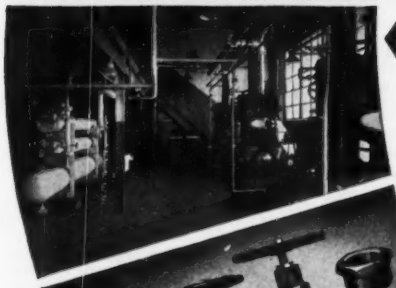
PROCESS EQUIPMENT FOR EVERY SERVICE

Stills, towers, oil chilling machines, filter presses, heat exchangers, etc. are constructed to all Codes. They meet all demands for operating security and trouble-free performance and help to lower costs in important process industries around the world.



SPECIAL MATERIALS FIGHT CORROSION AND PRODUCT CONTAMINATION

Our modern shops produce a wide variety of equipment made from special metals and alloys to combat corrosion, and product contamination or discoloration. Fabrication procedures employed insure that corrosion resistant properties of welds will match that of the materials from which units are constructed.

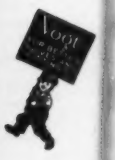


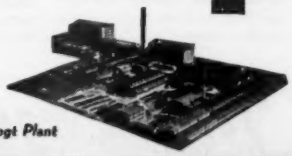
MORE TONNAGE AT LESS COST

Over 60 years of manufacturing experience, engineering and research stand behind Vogt refrigerating and ice making machinery. Absorption Systems, Compression Systems, and the Automatic Tube-Ice Machine in a wide range of capacities serve in leading petroleum refineries, chemical plants, ice and cold storage plants, dairies, packing plants, etc., at home and abroad.

DROP FORGED FOR EXTRA TOUGHNESS AND LONG-TIME SERVICE

Vogt valves, fittings and flanges, for top performance in oil, water, air, gas, and ammonia services, at high or low pressures and temperatures, are available drop forged entirely from carbon steel or stainless steel. Valves can be furnished in a combination of materials by using stainless steel for parts affected by service temperature or corrosion, and less expensive alloys or carbon steel for other parts.





Air View of Vogt Plant

HENRY VOGT MACHINE CO.

LOUISVILLE 10, KENTUCKY

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS

mands for aluminum since World War II have resulted in power demands beyond the capacity of existing hydroelectric systems to supply them.

In an effort to supplement its power generating facilities and thereby increase its aluminum-producing ability, the Aluminum Company of America constructed and began operating last year a plant at Point Comfort, Texas, which embodies a number of novel features. This plant, employing 120 radial gas engines, was completely described in the August 1950 issue of POWER ENGINEERING, so details will not be discussed here.

Aside from the fact that low cost gas fuel was available at the site, another reason for installing these engines was the fact that a large amount of direct current power was necessary. Each of the 120 engines drives a thousand kilowatt d-c generator, and also supplies 125 kva of alternating current power for use in driving the auxiliaries. Operating data on this installation is not yet available, although it is known that it has been performing very satisfactorily to date. It is clear that the designers of this plant expected to utilize low cost fuel efficiency without incurring transmission or conversion losses, and to secure lower first costs as well as greatly reduced maintenance costs through the compact, simplified design of the engine-generators.

The power for the reduction plant might, of course, have been secured in other ways, as from a steam generating plant or by purchasing power. As more information becomes public it will be instructive to compare the costs for this gas engine generator plant against the conventional power sources.

Thank you, friends—

for helping us to achieve
BETTER PRINTING—EARLIER MAILING

Advertisers and readers gain added values from early mailing and top quality printing.

With today's heavy and complicated color forms and open format, printing takes longer. With slower postal service issues must be mailed earlier.

To gain these objectives we moved the POWER ENGINEERING printing operations to Rumford Press, one of the finest and best known printing companies in the country.

All printing is done from monotype to produce better appearance. This means we need squared cuts. All color plates are run on patent base for closer register.

We need your further good cooperation to maintain the following closing dates:

1 Complete plates for advertisements in special positions and color advertisements must be in our hands not later than the 1st of the month previous to publication.

2 Final deadline for run-of-paper, complete black plates, is the 5th of the previous month. If plates are not received by this date we cannot promise proofs of the ad.

3 Insertion orders, advertising copy to be set, or ads requiring proofs for O.K. must be in our hands 10 days before final deadline above.

4 Cuts and plates should be shipped direct to
Mrs. Mary Curtice
POWER ENGINEERING
Care of Rumford Press
Concord, New Hampshire

5 Insertion orders, copy instructions, etc., should continue to be mailed to our Chicago address:
110 SO. DEARBORN STREET
CHICAGO 3, ILLINOIS

6 We will now be in a position to release your plates for use by other publishers by the 27th of each month prior to our publication date, which will help you in routing your plates.

Power Engineering

110 South Dearborn Street • Chicago 3, Illinois

LETTERS TO THE EDITORS

(*Continued from page 55*)

would be similar to a vector force diagram for a structural or applied mechanics problem. This would then require employment of accurate graph sheets and, for each variable property, a radian value or list of plus and minus co-ordinates to permit successive directional plotting. It would be necessary that magnitudes of all variables be expressed in the same system, English or metric. If this analysis is correct, the vector method would be very interesting fun, but also very cumbersome for solution of *any* property.

A much simpler but similar method is found in any of the numerous nomographs available, such as on pages 66–71 of the Crane Company Technical Bulletin No. 409, May, 1942. No graph sheets and separate tables are required for their use, but objection is found in that nomographs become faint and indistinct after usage, leading to possible errors.

Portland, Ore. CHET A. KERSHAW

HELPFUL BULLETINS

(*Continued from page 38*)

Domotor, electro-pneumatic, handwheel and combination models. Optional assemblies for specialized applications are also shown. Application information, operating characteristics given, and chief advantages of the valves are discussed — ease of maintenance, flexibility of installation. General specifications, capacity and flow information included. The Annin Co.

126 Hangers, Vibration Eliminators — Catalog 51 is a generously illustrated 96-pp collection of application and ordering data on pipe hangers, vibration eliminators and supports. Extremely helpful in writing specifications, covers functional hangers, overhead roller assemblies, rigid hanger assemblies, attachments to pipe brackets, tunnel supports, hanger parts. A technical section provides specifications, weights of piping materials, discusses some typical hanger problems and includes thermal expansion and flex-anal charts. Please give title when requesting this book. Power Piping Div., Blaw-Knox Construction Co.

127 Low Pressure Coupling — Bulletin 514 illustrates and describes manufacturer's low pressure Wedge-Lock coupling, a one-piece positive type, for connecting lightweight pipe in ventilating and similar low pressure service. Includes complete specifications on pipe sizes from 8 to 30 in. dia. Pictures simplicity of use. Naylor Pipe Co.

128 Improved Instrument Tubing — This 2-pp illustrated bulletin stresses low cost, long service life and easy handling of Dekoron tubing. Discusses corrosion resistance of this plastic-coated tubing, gives general specifications. Samuel Moore & Co.

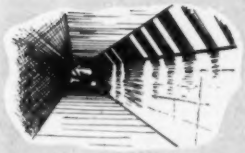
129 Sprinkler Head — An improved type of fire extinguishment head for

WHERE TO USE LUMNITE IN POWER PLANTS

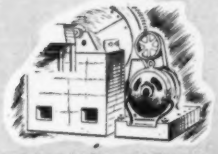
Steel Stack Linings

Ash Pit and Cinder Catcher Linings

Coal Bunker Linings



Flue and Duct Linings



Overnight Structural Concrete

Castable Refractories

Factory-prepared mixtures of LUMNITE and selected aggregates. Mixed with water on the job, cast into place for door linings, arches, baffles, furnace walls. Special shapes can be cast in molds, ready within 24 hours. Castables to meet different temperature and insulation needs are made by manufacturers of Refractories, sold by their distributors.

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SAVE TIME, CUT COSTS

with a CASTABLE REFRACTORY

Quickly adaptable to any size, shape or thickness, Castable Refractories made with Lumnite* are economical first aid for emergency repairs.

For baffles, furnace walls, arches, door linings, you get one-piece refractories that reduce heat loss, prevent infiltration of outside air. No shrinkage to bother about. High spalling resistance. Low upkeep.

They're easy to use, too. Add water to the packaged mixture, cast it in place or in a simple form or mold. Large jointless sections are as easy to cast as small special shapes. There's no cutting or fitting. And rapid hardening Lumnite Castables are ready for service in twenty-four hours or less.

You get time-saving, adaptable construction and long, durable service when you specify a Castable Refractory made with Lumnite. You get a balanced, tailor-made refractory that results from the blending of selected materials. You get suitable refractory aggregates with cold-setting, high-strength binder, Lumnite. Castables to meet different temperature and insulation needs are made by manufacturers of refractories and sold by their distributors. For further information, write to Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Bldg., New York 17, N. Y.

**"LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

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ATLAS® **LUMNITE for INDUSTRIAL CONCRETES**

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

A UNIVERSAL ATLAS PRODUCT

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

NICHOLSON W. O. TRAPS

STOP COSTLY LOSS OF STEAM AND AIR

With cost of steam and compressed air steadily increasing, these 3 leak-proofing features of Nicholson weight-operated traps are proving important cost-cutters in many plants:

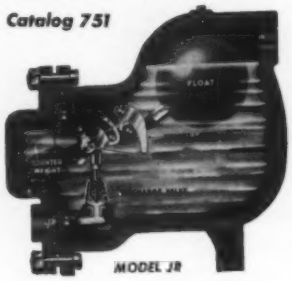
1) No air-wasting vent, such as is in all inverted bucket traps.

2) Positive water seal at valve. A Nicholson W. O. trap cannot lose prime and leak live steam.

3) Large orifice keeps valve clean, preventing blow-through.

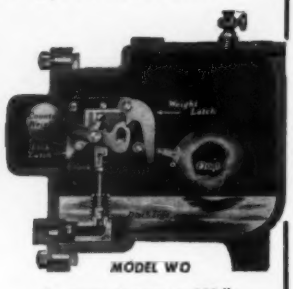
Three types, for pressures to 1500 lbs. Working parts of stainless steel.

Catalog 751



MODEL JR

for steam, air press. to 200 lbs.



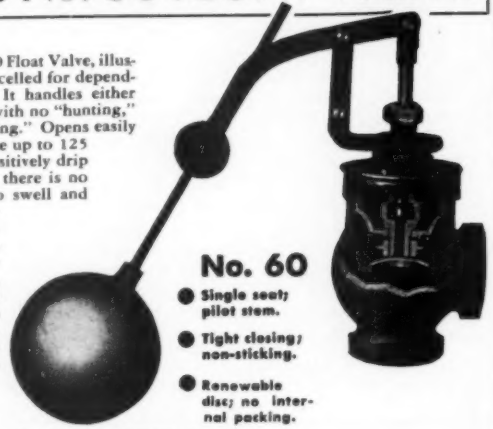
MODEL WO

for steam, air press. to 650 lbs.

W. H. NICHOLSON & CO., 160 Oregon St., Wilkes-Barre, Pa.

No Water Hammer! No "Hunting!" DAVIS No. 60 FLOAT VALVE

THE Davis No. 60 Float Valve, illustrated here, is unexcelled for dependable performance. It handles either hot or cold water with no "hunting," no "water-hammering." Opens easily against any pressure up to 125 p.s.i. and closes positively drip tight. No sticking; there is no internal packing to swell and cause excessive friction. Built in sizes ½" to 12". Standard construction—composition disc, bronze trim. All bronze or stainless trim available. Contact your distributor or write.



No. 60

- Single seat; pilot stem.
- Tight closing; non-sticking.
- Renewable disc; no internal packing.

DAVIS REGULATOR CO.

Established 1875

2308 So. Washtenaw Ave. Chicago 8, Ill.

use in fixed piping systems as either sealed or open head is described in this 6-pp illustrated bulletin. Shows how head is designed, tells engineering features, advantages. Rockwood Sprinkler Co.

MATERIAL HANDLING

130 What's New in Grab Buckets — Bulletins C-1, R-1 and RD-1 are on various types of grab buckets for handling coal, ore and other bulk materials. Those described include a bucket designed to work on the ends of operating lines of man trolley ore and coal bridge tower installations; one designed to work in the "bight of line" for fleet-through operation on rope system bridges and towers; one designed for steeple type towers. Special features of each type are outlined; specifications, photos of models and installations are included. Mead-Morrison Div., McKiernan-Terry Corp.

131 Conveyor Belting Manual — Catalog 31, on spiral woven wire conveyor belts and complete conveyor systems, contains 40 pp of information on standard and special types of wire belting weaves with specifications and detailed descriptions, full size illustrations. Power formulas and construction details are covered and suggestions provided for prolonging belt life and increasing efficiency. Korb-Pettit Wire Fabrics and Iron Works, Inc.

PUMPS, PUMPING

132 For Gas-Pipeline Pumping — Sixteen-pp Bulletin GEA-5530 presents company's combustion gas turbine for pipeline pumping. Describes features of the equipment, its application and operation. Well illustrated with photos, drawings, also charts showing horsepower limits for various ambient temperatures. A breakdown chart covering components of the turbine is included as well as sketches of typical installation buildings. Gas turbine control, remote supervisory control and accessories listed. General Electric Co.

133 Rotary Pumps — Eight-pp Bulletin WQ-50 describes in detail an improved rotary pump for discharge pressures to 250 psi with capacities to 1000 gpm depending on liquid handled and pumping conditions. Sectional and exterior views of pump included, also dimensions, specifications and selection chart. Economy, versatility and quiet operation stressed. Warren Steam Pump Co., Inc.

134 Reciprocating Pump — Data Sheet 67-A, 8 pp, describes company's new 6-in. stroke direct flow pump series. Gives full details of design and construction including dimension and sectional drawings, performance data and pump specifications. The Aldrich Pump Co.

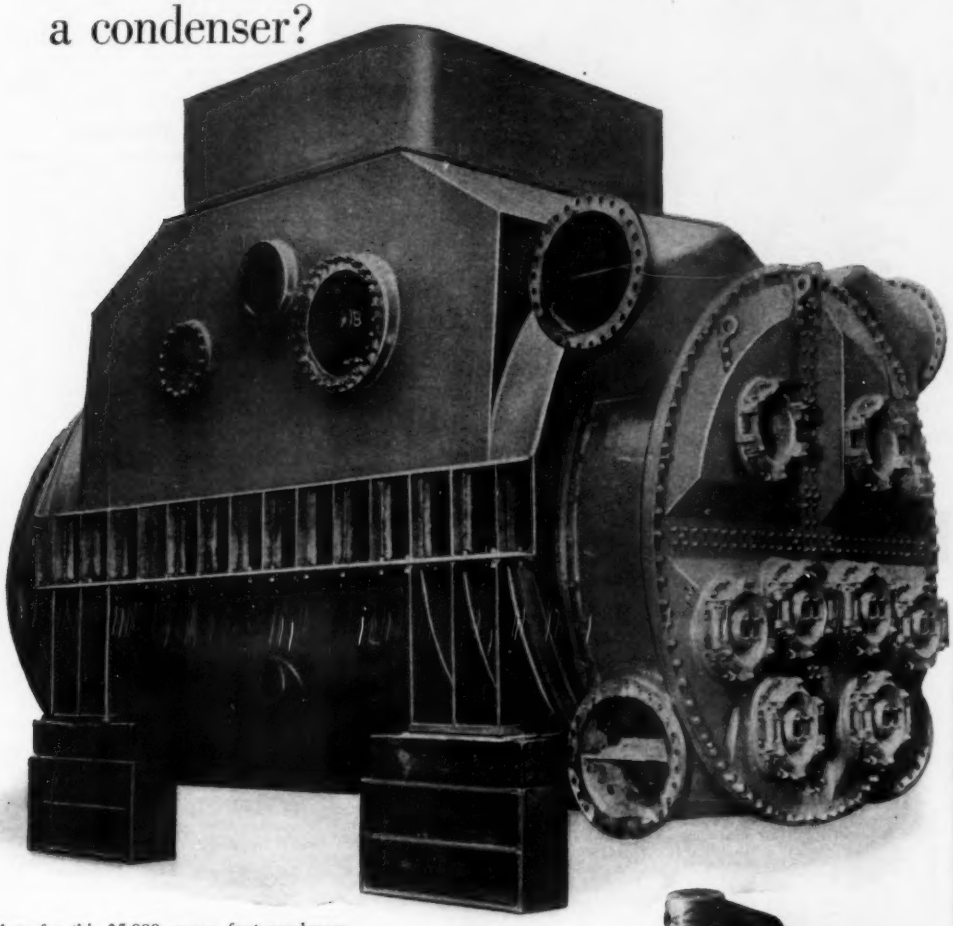
MAINTENANCE

135 What To Do About Those Floors — "Over the Rough Spots" is a 32-pp pocket-size booklet giving an analysis of floor problems. Well illustrated, tells where to look for and correct bad floor conditions; tells how to protect both concrete and wood floorings and maintain proper repair by comparatively unskilled personnel. Stonhard Co.

136 Facts About Floor Safety — How to make floors as safe as possible is the subject of this 20-pp booklet. Three factors are cited as providing safer floors: proper initial finishing, correct methods of routine maintenance, use of right products. Details recommended finishing techniques and maintenance methods for asphalt and rubber tile, linoleum, wood, concrete and terrazzo flooring. Lists danger points in maintaining various types of floors and gives practical floor care hints about cleaning, polishing, touching up and refinishing. S. C. Johnson & Son, Inc.

137 Chemical Cleaning — A modern method of removing deposits from internal heating surfaces is described in this 12-pp booklet. Explains chemical cleaning of steam boilers, discussing equipment, solvent and inhibitor used. Also covers

What are U. S. Rubber packings doing on a condenser?



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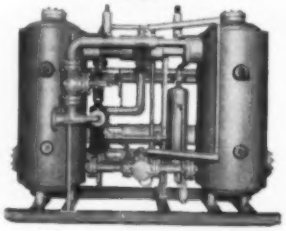

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chemical cleaning of new boilers to remove mill scale deposits, cleaning of economizers and other equipment. Tells how to prepare boiler for chemical cleaning. Sumco Engineering Co., Sumco Products Inc.

138 Cathodic Protection Slide Rule — Designed to assist power engineers concerned with cathodic protection of pipelines is the magnesium anode cathodic protection guide. With pipe size and resistivity known, the slide rule gives required magnesium anode size and life, length of pipe protected, and current output. Please give title when requesting slide rule. Federated Metals Div., American Smelting and Refining Co.

OTHER EQUIPMENT

139 Gas-Engine Driven Compressors — Bulletin 113, 16 pp, presents construction details and engineering features of company's Model HLA two-cycle compressors showing how these features contribute to long service, operating economy and flexibility of arrangement. Compressors in this line have 17 in. bore, 19 in. stroke, are available in 5, 6, 8 and 10 cylinder units of 1250 to 2500 Bhp. Several installations of these compact, large capacity compressors are pictured; specifications, dimensions included. Clark Bros. Co., Inc.

140 Forced Draft Fans — Illustrated Catalog 300, 8 pp, tells how these forced draft fans offer improved performance, describing in detail their blade design, larger inlet cones, disc design. Single- and double inlet types are pictured, general characteristics discussed. The Thermix Corp., Prat-Daniel Corp.

141 CMP Record Keeping — The answers to many record keeping problems arising under the Controlled Materials Plan are described in Booklet X-1203, a collection of data sheets in filing binder. This practical manual outlines methods for simplifying paper work by laying the groundwork for getting the desired result, a properly balanced and interrupted flow of materials to meet requirements on schedule. It shows ways to save on clerical routine, as well as incorporating information necessary for the correct set-up of records required for efficient operation under CMP regulations. Management Controls Div., Remington Rand Inc.

142 Time-Saving Templates — Catalog 50 is a concise 8-pp ordering guide picturing and describing more than 40 drafting templates covering a wide range of engineering symbols. Includes electrical, piping, processing, welding, instrument, gears, fasteners and other types, also sets. Prices given. RapiDesign Inc.

143 Return Line Corrosion — Bulletin 5013 covers the causes of return line corrosion and company's corrective treatments — a formula which dissolves in the condensate and reacts with carbon dioxide to prevent carbonic acid, and a new filming type amine formula which forms a continuous film in return lines, coating them against both oxygen and CO_2 corrosion. Includes test procedures for both treatments. Dearborn Chemical Co.

144 Fine Coal Dryer — A new, improved dryer for fine coal is announced in 6-pp Bulletin 551. Gives a detailed description of the Pulso unit, a thermal dryer of the up-draft type. A complete installation is illustrated along with an operational diagram showing the complete flow of the coal and hot gases. Temperature and gas flow controls are pictured and a complete engineering drawing of a fine coal drying arrangement is included. McNally Pittsburg Mfg. Corp.

145 Stainless Croloys — A 106-pp pocket-size handbook with flexible leatherette binding, Bulletin 1-B is devoted to properties and methods of working seamless and welded tubes and pipe of company's stainless croloys. Data provided includes

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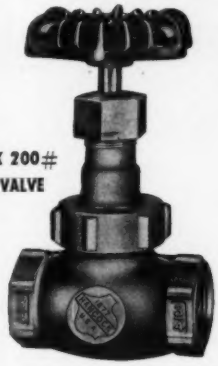

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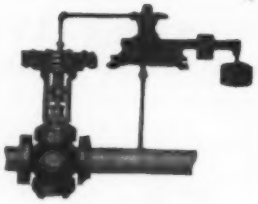

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analyses of austenitic and ferritic stainless croloys, corrosion and oxidation resistance, methods of working and fabrication, also mechanical, physical properties and other information on various croloys. Available to qualified power engineers, please state title. The Babcock & Wilcox Tube Co.

146 One Coat Does It — This small illustrated folder describes an improved finishing cement that insulates. Discusses composition, adhesion and shrinkage characteristics, thermal efficiency, coverage, workability. Baldwin-Hill Co.

147 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel and heating oils, dust control. Examples of increased production and lowered costs resulting from use of this service are cited. Gulf Oil Corp., Gulf Refining Co.

148 O Ring Seals — Catalog 502B is an 8-pp engineering manual giving all necessary information on the use and selection of silicone O ring seals. Includes data on proper design of mechanisms and equipment using O rings, importance of designing for proper O ring installation, illustrations of good designs for simplifying installation and precautions to be taken to avoid damage to seals. O Ring Dept., Arrowhead Rubber Co.

149 Atomic Defense Plan — "How to Prepare Your Plant for Atomic Attack" is a 32-pp booklet presenting factual information about the atomic bomb, its destructive potential and its limitations. Tells how to organize personnel to cope with possible disasters. Walter Kidde & Co., Inc.

150 Processing Equipment — Twelve-pp Bulletin 50-1 illustrates and describes equipment designed and manufactured for the process industries. Material is grouped according to use for which equipment is designed. Several pages are devoted to case histories showing the initial problem, its solution and results. Infilco Inc.

151 Hydraulic Power Units — Twelve-pp Bulletin 210 illustrates and describes a line of hydraulic power units and bell-mounted motor-pump units. Lists all of company's 312 standard models. Presents detailed performance and application information and recommendations for the selection and installation of hydraulic power units for any specific power requirement. Also includes information on custom-built models, optional extras. Haskel Engineering & Supply Co.

CATALOG LIBRARY

(*Continued from page 48*)

ous impurities in water, outlines 12 methods of treating water to eliminate these impurities, describes reasons for the popularity of the hot-process method and its advantages, explains chemistry of hot-process water softening. Graver Water Conditioning Co.

247 One-Minute Water Tests — Rapid, simple and accurate tests for determining water hardness are described in Bulletin 1RE50, 4 pp. Procedures, reagents, and equipment are pictured and described. Bulletin tells how tests may be used to determine water hardness, hardness due to calcium alone and hardness due to magnesium alone. Hall Laboratories, Inc.

248 Boiler Water Treatment — Bulletin 47, 8 pp, is on internal treatment of boiler water. Defines internal treatment and tells its advantages in softening, sludge conditioning, stabilisation. Explains operation of company's system, including the chemicals used. National Aluminate Corp.

249 Ion Exchange Systems — "Amberlite Monobed Deionization" is a 12-pp miniature textbook covering the history, behavior, present performance, and potential uses of the Monobed ion exchange systems in water-conditioning, chemical processing and other industries. Reactions of various combi-

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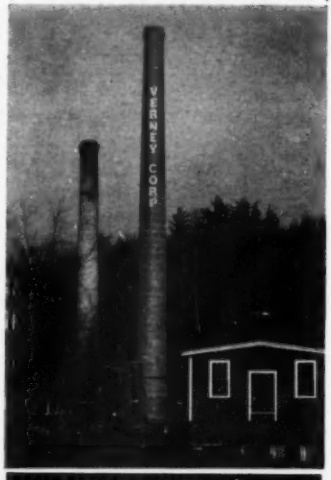

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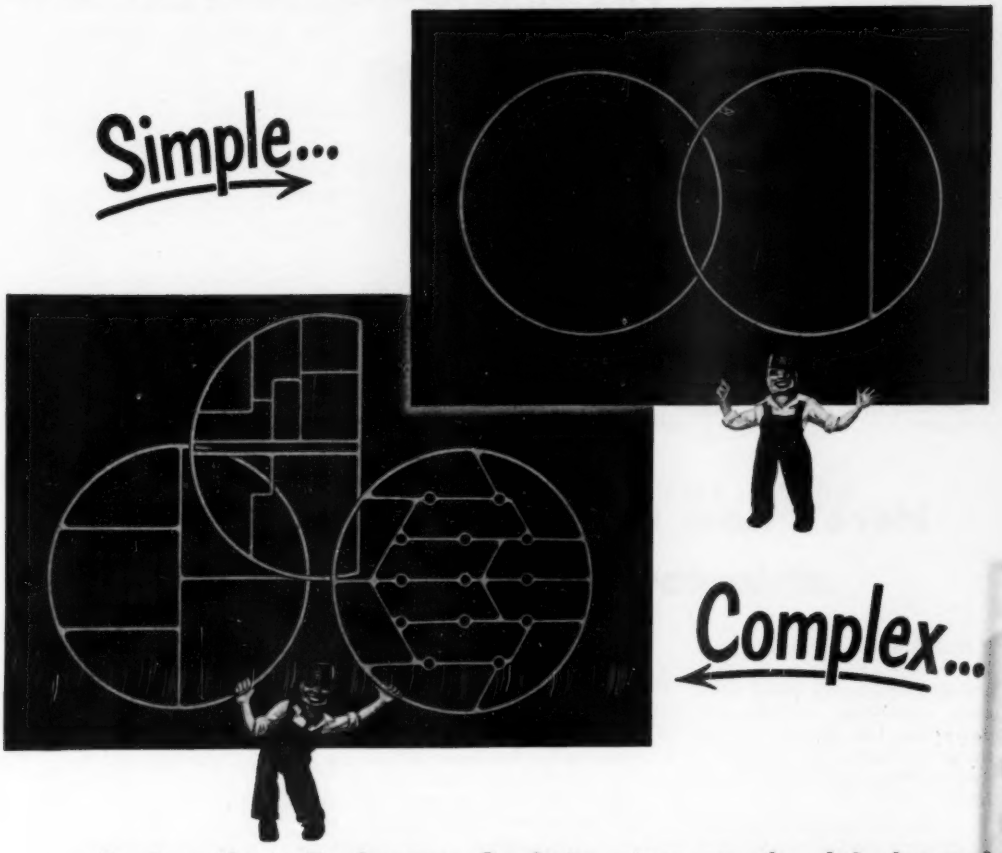

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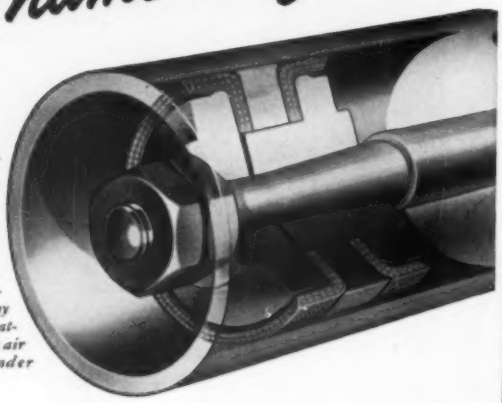

Phantom cutaway showing typical Pumcup-piston assembly—one of many types for all reciprocating pumps as well as air or hydraulic cylinder mechanisms.

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nations of exchangers are explained in text and equations. Also discussed are operating costs, equipment costs, quality of product derived, rinse requirements. The Resinous Products Div., Rohm & Haas Co.

250 Chemical Treatment of Water — Bulletins describing various methods of chemical water treatment, including company's Coravol process, are now available. Coravol is part of a complete technical service which provides special chemical formulas for boiler feed water, foam prevention, hot water supply, refrigerating brine, cooling and condenser water; the bulletin on this subject describes the process in detail. Western Chemical Co.

251 Boiler Water Manual — Factual information on standard methods of applying chemicals in the treatment of water for boilers is presented in this 16-pp technical bulletin, called Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and to feedwater system, condensate returns, flushing. %Proportioneers, Inc.%

252 Water Softening Equipment — How the problems caused by hard water can be offset by the use of water softeners is explained in Bulletin 2386, 12 pp, describing ion exchange equipment. It covers in detail downflow, upflow and gravity zeolite water softeners. Illustrates a fully automatic softener. The Permutit Co.

253 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations to suit individual plant requirements. Covers pretreatment, internal treatment, treatment application, blowdown adjustment and test control. Filled with illustrations, also describes available equipment and includes a reference bibliography of literature on specific formulations. Dearborn Chemical Co.

254 Boiler Corrosion — A 12-pp article discussing the cause and prevention of corrosion in boiler systems is presented in Bets Technical Paper No. 111 titled "Corrosion: Its Effect in Boiler Systems." The corrosive effects of oxygen, carbon dioxide, ammonia, hydrogen sulfide, acidity, physical factors evaluated. W. H. & L. D. Bets.

255 Zeolite Water Softeners — Publication 4530, 16 pp, presents hydrogen zeolite (cation exchange) water softening equipment. Gives complete description of the process and the field of application, showing advantage of hydrogen zeolite softening and its relation to sodium zeolite softening process. Bulletin not only provides an exhaustive explanation of the new process but of the zeolites themselves. Cochrane Corp.

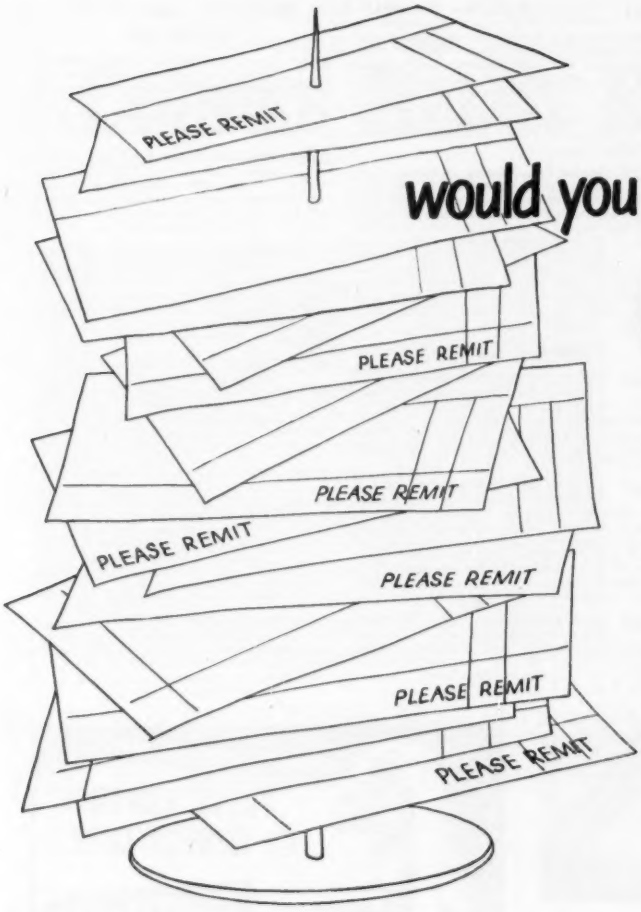
256 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a 4-pp folder covering amine treatment for inhibiting of boiler and condensate systems. This treatment is described as affording surface protection of the metal itself as well as raising the pH value of the condensate. The Bird-Archer Co.

257 Slurry Type Softener — Six-pp Bulletin W-212-B6 describes a slurry type precipitating softener and coagulator in which energy for floc preparation is mechanical, explaining and illustrating flow circuit. An excellent question-and-answer appraisal of system is included, equipment pictured. Worthington Pump and Machinery Corp.

258 Organics in Water Treatment — Here's an interesting 4-pp folder describing the need for organics in altering the nature of sludge in order to make it nonadherent. Covers theoretical and practical considerations involved in use of organics; describes manner in which they overcome problems of sludge. Power Chemicals Div., E. F. Drew & Co., Inc.

FUEL OILS, LUBRICANTS

259 Fuel Oil Treatment — By text and sketches, this folder points out undesirable conditions in the storing, pump-



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ing, heating and burning of industrial fuel oil and the correction of these conditions by company's fuel oil treatment. E. F. Drew & Co., Inc.

260 Grease Application Devices — The development and use of many types of lubricating devices are discussed in an excellent article in Vol. 36, No. 9 of Lubrication, company's technical publication on lubricants. Covers the pressure gun, spring type grease cups and several types of power driven grease lubricators, explaining such points as the judicious use of pressure measured lubrication, pumpability characteristics of lubricants. The Texas Co.

261 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp illustrated book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and their applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, and safety precautions. Cities Service Oil Co.

262 Diesels, Their Fuels and Lubricants — This 46-pp book offers a well organized and attractive presentation of practical information on diesel engines, covering their history and economics as well as their design characteristics and operating principles. Classification of diesels according to speed is explained. Other chapters cover injection systems, combustion chambers, lubricating systems, and diesel oil purification and filtration. Includes a discussion of fuel and lubricating oil required. Sinclair Refining Co.

CONDENSERS

263 Steam Condensers with Reserve Flow — Eight-pp Catalog 410-1 describes a "self-cleaning" reverse-flow condenser for power plant service, designed to virtually eliminate cleaning down time and, in the case of divided water box condensers, eliminate operation at partial load. C. H. Wheeler Mfg. Co.

264 Ejector Instruction Manual — Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures, steam nozzles, condensing water, raw water cooling, recirculation and removal of condensate. Fully illustrated. Foster Wheeler Corp.

265 Steam Condensers — Bulletin 102, 24 pp, is a comprehensive presentation of manufacturer's steam condensers and includes photos of six typical installations as well as a section of engineering data, a discussion of air removal equipment, and a chapter on condenser maintenance. Such special equipment as company's Wizard injector to seal small leaks while condenser is in operation, air erosion eliminators, divers lights and port gages are also described. Condenser Service & Engineering Co., Inc.

HEATERS, HEATING

266 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-pass, four-pass and six-pass designs, with tube bundles removable for inspection. Davis Engineering Corp.

267 Heat Exchangers — Bulletin 114, a small folder, gives concise information on company's Aero heat exchanger with balanced wet bulb control designed to cool engines or process equipment, coolants and lubricants, liquids and gases for processing operations. Cutaway drawing shows how exchanger operates, installation photos show some applications. Niagara Blower Co.

268 Heat Exchangers — Bulletin 11.0-080 describes air cooled heat exchangers for condensing or cooling of steam or process vapors, natural gas, jacket water, lubricating oil, quenching baths. Equipment Div., J. F. Pritchard & Co.

COAL, ASH, AND WASTE HANDLING

269 Coal Handling Equipment — Modern equipment for the storage and handling of coal and ash is presented in 24-pp Bulletin 300. Illustrated, covers concrete and tile silos, cylindrical steel tanks, suspended steel bunkers. Gifford-Wood Co.

270 Spreader Stoker Selection — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

271 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

272 Coal Scale — Bulletin 0250, 12 pp, describes a pressure-tight, automatic coal scale, its construction and operation. How beam system, electrical components and linkages are protected from exposure to coal dust, explained and illustrated. Typical installations pictured. Richardson Scale Co.

273 Efficient Coal Preparation — Facts and features concerning improved coal preparation for power plants are presented in this 8-pp illustrated booklet. Shows how coal is split, not crushed, by rolling ring principle utilized in company's equipment to provide better combustion and reduced ashpit loss through uniform low-cost coal sizing. Tables show relation of sizing of coal to ashpit loss. American Pulverizer Co.

274 Spreader Stoker — Bulletin 890, 40 pp, describes a spreader stoker with overthrow rotor designed to provide uniform fuel distribution. Discusses advantages of this type of stoker, including its efficiency in the

(Continued on page 134)

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Continuous records of the oxygen dissolved in boiler feed water and of the hydrogen entrained in steam, indicate when corrective measures are necessary to prevent otherwise unsuspected and costly corrosion. Cambridge Analyzers measure and record dissolved oxygen directly. The hydrogen in the steam is measured and indicates the quantity of oxygen set free by dissociation. Cambridge Instruments are available for continuously recording either O_2 or H_2 separately, or O_2 and H_2 simultaneously.

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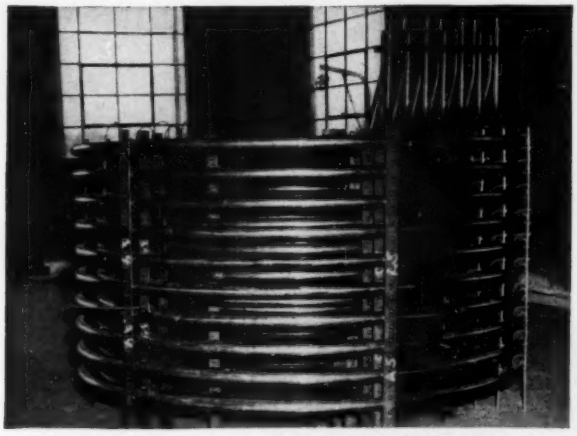


Heating and cooling coil made from Stainless Steel-Cupro Nickel Duplex Tubing

Stainless Steel-Cupro Nickel Duplex Tube for Heating and Cooling Coil

Controlling the temperature of various chemical reactions is often a major problem in the chemical industries. Some heating is required in the early stages to help activate these reactions. However, as soon as it is under way heat is generated so rapidly that it must be cooled to the proper temperature in order to produce a satisfactory product and prevent decomposition of materials. In addition, the presence of various acids in the solution is often too corrosive for ordinary materials.

Stainless Steel Coil Failed

The coil illustrated above was originally constructed from stainless steel tubing 2¼" O.D. x .218" wall thickness. Ordinarily, stainless steel would have been a suitable material of construction in the particular chemical service involved.

On the other hand, although stainless is highly resistant to many corrosive elements, it is vulnerable to stress corrosion cracking, particularly in the presence of chlorides. Failures were encountered in the stainless coil primarily from the inside surface of the tubing in the form of stress corrosion cracking due to the high chloride ion found in the raw water used for cooling.

Stainless Steel-Cupro Nickel Duplex Coil Effective

Since most of the copper-base alloys are resistant to cracking and corrosion from water and brine, it was decided to solve this problem by constructing the coil from Duplex tubing with cupro nickel to the circulating water side and stainless steel to the product side. Aside from its superior corrosion resistance the Duplex tubing has approximately 25% higher heat transfer rate than straight stainless steel.

From a construction standpoint, the coil is more difficult to fabricate than the straight stainless type. To obtain the required fast cooling rate, a large surface area must be presented to the liquid to be cooled. Furthermore, a rapid change in circulating water must be effected. Consequently, this special coil was designed with seven separate coils nesting together. The outer coil is approximately 8 ft. in diameter and is made from 262 ft. of tubing. The inside coil, which is the smallest, is approximately 3 ft. in diameter and made from 158 ft. of tubing. The Duplex tubing used for the construction of this coil was 2¼" O.D. and both the outside stainless steel component and the inside cupro nickel component had a wall thickness of 0.109".

Joining Duplex Tubing by Heliarc Welding

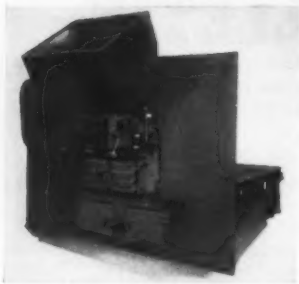
An ingenious method was used to join the 24 ft. lengths of Duplex tube to make the continuous length required for each of the coils. To protect the cupro nickel from the corrosive products, it was necessary to join stainless steel to stainless steel and cupro nickel to cupro nickel. To prevent contamination of the stainless weld with copper, a special low-carbon content Type 304 stainless tubing was used for the outside component of the Duplex combination. First, the outside layer of stainless steel at the ends to be joined, was cut back approximately ½". Then the cupro nickel ends of the two tubes were butted and welded with a special welding rod by the heliarc welding process. Then the outside layer of stainless steel was built up by heliarc welding.

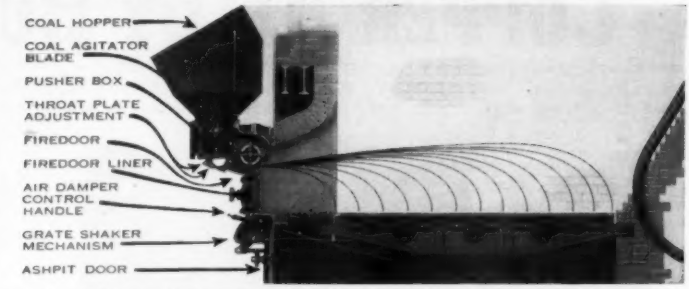
The above represents an extreme case of construction involving the welding of Duplex tubing into long lengths, coiling, etc. Most applications for Duplex tubing require straight lengths that can generally be fitted into the headers of condensers and heat exchangers similar to single wall tubing. Unless conditions are exceptionally severe, requiring cupro nickel for example, most applications may use copper, Admiralty, brass or aluminum bronze towards the circulating water side. The increasing use of Duplex tubing in an ever widening list of applications attests its superiority over single wall tubing for solving difficult corrosive conditions and for reducing costly maintenance. (7153)

CHICAGO AUTOMATIC

Unit Drive

SPREADER STOKERS





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- ✔ Absence of complicated or bulky driving mechanism.
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For complete information write Dept. F. 7 for Publication No. 85 ●

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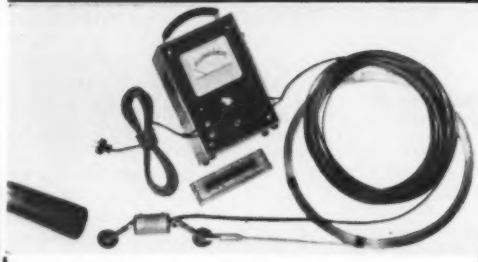

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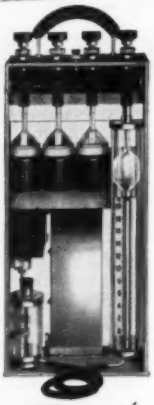

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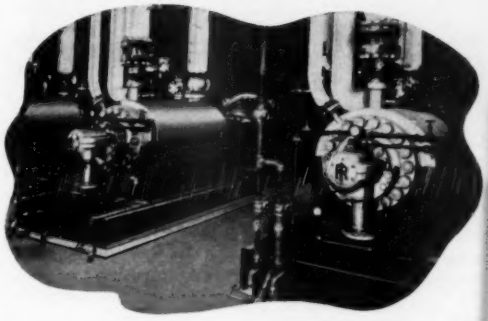

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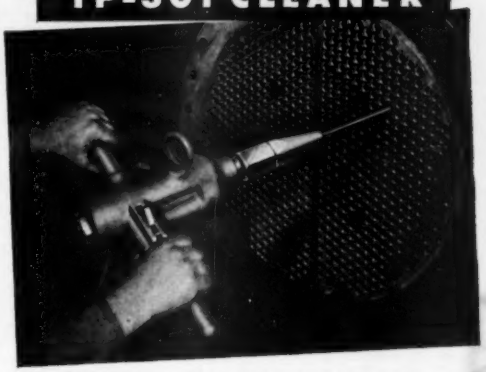

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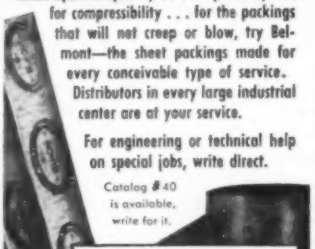

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(*Continued from page 128*)

burning of many grades of coal and in handling of fluctuating loads. Power-operated and hand-operated dumping grates and stationary grates are shown. Detroit Stoker Co.

276 How to Cut Waste Costs — A factual treatise, "Four Ways to Economize on Industrial Wastes," discusses briefly main types of industrial wastes and special problems involved in their handling. Explains ways of coping with waste costs by reduction of waste volume, by improved processing methods, by conversion of wastes to by-products and by treatment. Gilbert Associates, Inc.

FANS, BLOWERS

280 Mechanical Draft Fans — An extensive line of mechanical draft fans for both forced and induced draft service is described in 20-pp Bulletin 168. Illustrated with drawings of typical fan types and photos of installations, also includes performance curves showing efficiencies of various types of fans. Gives construction features, drive arrangements, mounting methods. The Green Fuel Economizer Co., Inc.

282 Blowers and Accessories — Engineering and dimensional information on low, medium and high capacity blowers is given in this recently released 6-pp bulletin. Pictures some installations, also accessories for use with the blowers. Blower-Stoker Div., Read Standard Corp.

OTHER EQUIPMENT

288 Fundamentals of Hydraulics — Technical Bulletin B-4 is a newly revised 44-pp guidebook covering essential information on hydraulic systems, maintenance trouble-shooting and selection of proper fluids. Besides offering well-organized reference data to engineering personnel, this book is suggested as a training manual for maintenance supervisors, operators and apprentices. It features specially prepared phantom and cutaway drawings illustrating functions of basic types of valves, pumps, hydraulic motors, torque converters. Shows function of each component part. Sun Oil Co.

289 Turbine Catalog Collection — This is a valuable collection of bulletins covering a complete description of solid wheel turbines. They feature cross section drawings of typical units for both moderate and high steam pressure conditions. Includes data on speed increasing and reduction gears. The Terry Steam Turbine Co.

291 Paints to Beat Corrosion — This 8-pp illustrated bulletin is devoted to company's line of anti-corrosive paints. Discusses their sub-oxide of lead base and other technical properties and points out savings in time and money afforded by the use of these rust-inhibitive coatings. Describes primers, finishing coats and single coats available; tells how to apply them. Also discusses painting of galvanized structures. Subox, Inc.

292 Dehydration Systems — This 4-pp bulletin presents pressure type and gravity type dehydration systems for cleaning, stabilizing, and degasifying lubricating oils. Explains their features, sequence of operation. Illustrated; includes specifications, dimensions and weights. Bowser, Inc.

294 Bibliography on Nickel Alloys — Sixteen-pp List A covers company's technical papers and commercial publications on nickel alloy steels, stainless steels, nickel cast irons, nickel brasses and bronzes, and nickel plating, and their uses. Material listed is available. The International Nickel Co., Inc.

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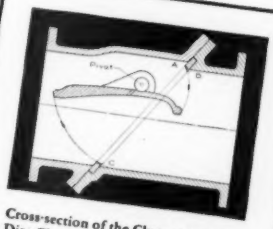

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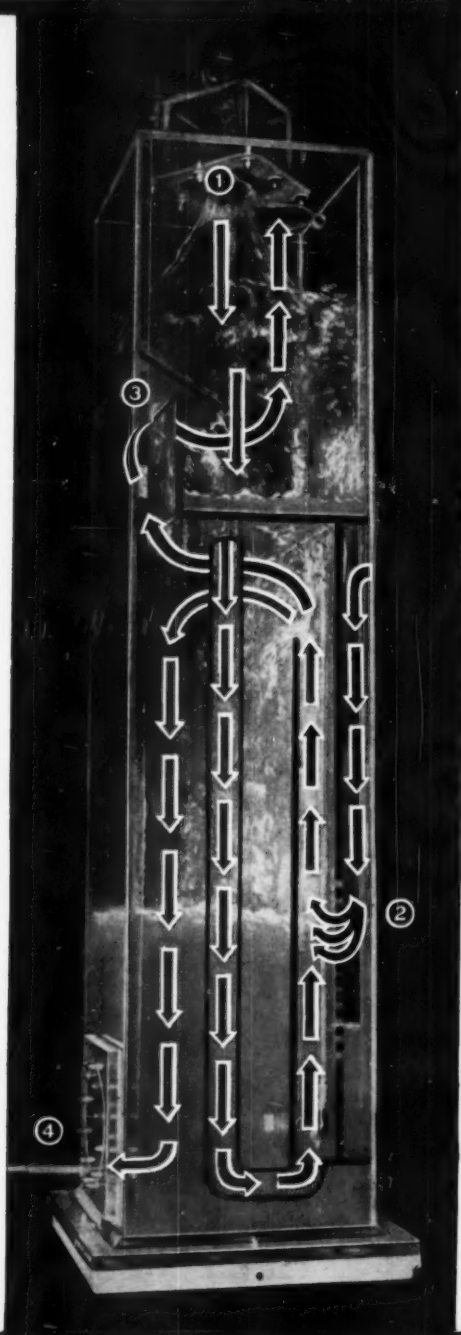

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